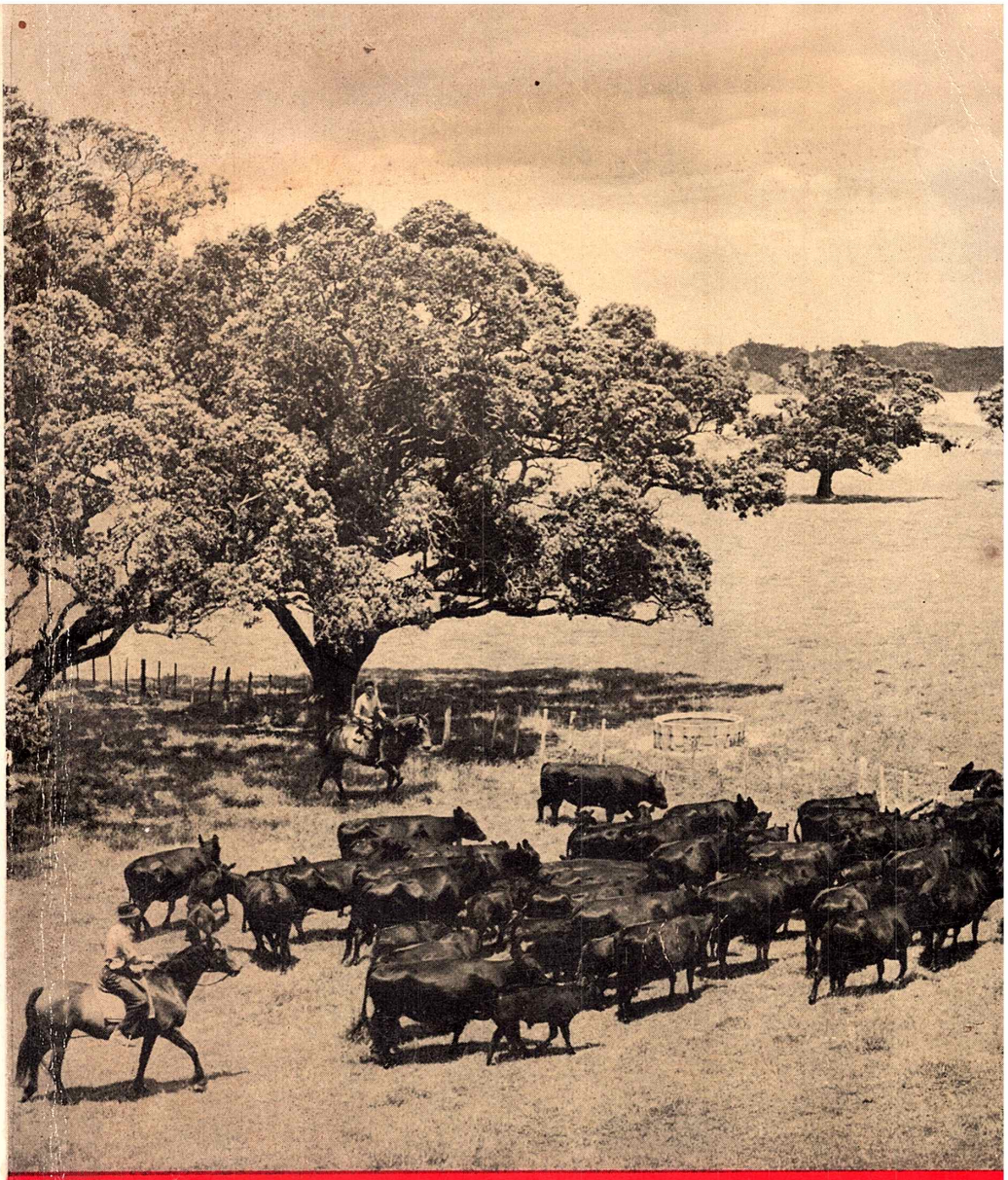
SHEEPFARMING ANNUAL 1965



SHEEPFARMING ANNUAL 1965

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PATHFINDING IN HILL COUNTRY SHEEP AND WOOL PRODUCTION

J. A. H. INGLIS*

IN 1947, development of a property of 840 acres, carrying 1.5 ewe equivalents on a low plane of nutrition, was begun. In 1949, management of the property was assumed. To date, without the introduction of further capital, the business has been expanded to 1,150 acres which this year will carry into lambing 6,500 ewes, 1,000 hoggets, 70 rams and 70-odd two-year steers — say 5.65 ewes and 0.9 other ewe equivalents, or better than 6½ ewe equivalents — and the stock are well nourished. The permanent staff of two partners were happy doing the work that up to 5,000 ewes involved, but have now taken on an assistant.

It appears that the results achieved are better than average, and the purpose of this discussion is to establish (1) How production has been raised to its present level (and it should be emphasized that production is still increasing); (2) what better methods would now be employed by the partners to achieve these results; (3) why a lower-than-average labour force has been and is adequate.

There is no doubt that good fortune has been a factor in the success of the enterprise. Nevertheless, it is felt that the approach to hill-country sheep farming which has been adopted may have application to many parts of New Zealand.

Basic Philosophy

A long time ago, we saw two truths. If these are remembered, they will prove of more benefit than any technical points in this paper. The first is that a person must be prepared to justify anything which he does or believes. To justify oneself to others is merely face saving. It is justifying oneself to oneself that is important. Among other things, it saves many unnecessary jobs being undertaken. The second belief is that whatever is to be done, there is always a better, easier or cheaper way of doing it, and having achieved this, the same truth still applies. This approach has saved us from falling into that peculiar cult of ancestor worship, common in New Zealand, which requires the farmer not to think for himself, but to work in strict

* "Ratahiwi", Woodville.

accordance with a diary drawn up by an earlier generation. In fact, one is not honouring one's ancestors unless one learns what they know and then progresses from that base.

The way to increased stocking is to do what is necessary to make the pasture grow, and then put on extra stock just before it grows. This may take courage, but if a person has no courage he does not go into business on his own account.

The Property

"Ratahiwi" is in the upper Manawatu basin, four miles north of Woodville. The climate is cool, influenced by exposure to strong north-west winds, with a well-spread rainfall averaging 54 inches at the homestead. This would be much higher on the mountain slope. Elevation is 500 to 1,200 ft, but mostly between 550 and 1,000 ft. Frosts are not very common owing to the high wind run.

Easy hills, of alluvial pumice origin and partly discable, with wet valleys containing iron pans and boulders comprise over half the original block of 840 acres while towards the Ruahine Range there are extensive boulder beds and then steeper hills running on to the main mountain slope. These latter parts are mainly of greywacke origin. Fertility was originally low. The pumice soils are Matamau silt loam type 77b.H., and the Ruahine soils type 124.

This area, together with 100 acres purchased in 1951, also alluvial pumice hills, was that occupied during the period in which we developed our methods. The financial results from development were sufficiently good to enable two more sections to be purchased during the last twelve months. Each was of 100 acres of alluvial pumice hills at prices averaging in excess of £100/acre. One of these sections has been occupied since August, 1964. It was too steep and wet for the dairy herd it carried previously and the pasture has been built up from a buttercup-dominated condition. This section will carry 700 ewes this year. The other section was taken over in May, 1965, and had no history of topdressing. It was sown with 2½ cwt molybdic superphosphate and 2 cwt DDT superphosphate and is projected to run 500 or 600 ewes. This number should increase quickly, particularly as some gorse requires clearing.

Partnerships

Some form of partnership has definite advantages over the sole trader, provided of course that the partners are

compatible. It is particularly valuable where the owners have a desire to achieve an improvement in their business. It seems the reason most professional persons enter into partnerships is the same as that which makes two sheep-worrying dogs much more formidable than lone rangers; what one partner does not think of, the other does. Something like this has certainly applied to our business and has helped us to progress. However, complex company and trust arrangements for farming businesses are not advocated.

Stocking Rates

The big factor in the development of our pastures has been utilization. The endeavour has been to follow the lead given by Grasslands Division, D.S.I.R., to have all the grass used by the grazing animal as it grew, thus making it grow faster and extending the growth through what used to be dormant periods. This can be achieved only by endeavouring to have every paddock stocked all the time. Much help has been received from research and extension workers, though some of the latter have poured some cold water as well. The late Dr Peter Sears, by his personal prodding, helped give us the courage to push up stocking rates beyond the accepted levels for commercial hill sheep farming. The extra stock have been carried at little additional cost, with the obvious result that our pockets have benefited.

The Early Period

"Ratahiwi", in 1947, barely fed 950 ewes, 400 other sheep and 30 or 40 cattle; wool production was 11 to 14 lb/acre. The future did not look very bright, and we had no conception of the scale increases which have, in fact, been possible. Because income from the farm was not enough to make it an attractive proposition, we considered selling out. However, the market value of "Ratahiwi" was about £14 per acre, and it seemed, at that price, little would be lost by staying there. While we liked farming, our interest was in making a better income. The enthusiasm which has made farming into a hobby as well as a business has grown with financial success.

In 1947, a small wheel tractor was purchased, and this same year 25 tons of superphosphate were sown by hand. The same method of sowing was used for rather larger quantities in the succeeding two years. A blower was used

for topdressing in 1950; since then, of course, the aeroplane has been used. Without the aerial industry, hill farming would not be what it is today. At the same time, one has the feeling that much of what is sown is not put to appreciable use.

Considerable numbers of cattle were run in the early stages of development. Except for about a hundred acres of valley bottoms, the pastures were in the unattractive condition common to much of New Zealand at the time. Browntop had become the dominant grass species, closely followed by bidi-bidi, hard fern occurred in large and rapidly spreading patches on steeper faces, manuka was becoming aggressive, though kept down, and quite an appreciable amount of bracken was present. Gorse and blackberry had not been allowed to become a problem, except that the land purchased in 1951 was half covered with them.

Comments on the use of cattle really apply to the 840 acres owned before 1951. No breeding cows have been run since 1950. Commencing in 1949, only steers have been purchased. In earlier stages, 200 to 300 steers and bullocks were worked. They were sold as stores only, and if feed ran out, some of them were sold. Several mobs of grazers were taken in. The most notable of these was one of 350 three- and four-year heifers which was on the property for six weeks in early spring. These heifers lived on two paddocks and ate all the hard fern bare; then, having eaten the softer bits off the logs, they pulled up the hard fern roots and ate them too. The hard fern never grew much again. It is worth noting that the owner of the heifers was very pleased with the way they thrived.

For several years, weaners were purchased and fattened at three-and-a-half years. With increases in sheep, however, the weaner became less attractive. Eighteen-month steers have been bought instead and fattened the following year. The numbers of cattle run were stepped up to 200 in the early 1950s, then scaled down as roughage was cleaned out —about 100 cattle by 1960, and rather less since then. During lambing, numbers were reduced to 40 in 1963, and in 1964 all were sold as conditions were much wetter than ever before. About 50 will probably be kept on the 950 acres this spring, and more bought in the summer. Farming without cattle for several months in 1964 convinced us that some cattle are required all the time, even though farming of sheep is preferred.

Some trial and error approaches have determined what is the best sheep stocking policy for our particular land, and

our pockets. Fortunately, it appears the same policy is best for both. The number of ewes was built up to about 1,400, then carry-over lambs bought in so that considerably more hoggets than ewes were being run. Returns from the ewe hoggets were quite attractive, and of course weaner steers did well along with them. However, a grazing hogget is not nearly as good a developer of pasture as the grazing ewe, so now only a low proportion of hoggets is run. It is intended to keep these as breeding ewes. Wethers were tried but were most unsatisfactory both for grazing control and pasture development. Financial results from them were not pleasing either.

Our ambition is to achieve the "carpet of grass" first suggested by Sir Bruce Levy. This can most nearly be realized by exploiting the grazing of the breeding ewe. Consequently, for some years, two flocks have been run. One quarter of the ewes are Perendales, maintained by buying-in, and mated to the Southdown. These are run on the higher, steeper part of the farm with greywacke type soils, and which lies across a flooding stream which can occasionally make access difficult at lambing. Three-quarters of the ewes are Romney, of which the tail-end third are mated to the Southdown, the remainder to the Romney. The policy is to breed enough Romney ewe lambs for replacements and some increase, but in actual practice carrying capacity has increased faster than anticipated, and considerable purchases of ewes have been necessary. We think we can breed better than we buy, so the presence of bought-in Romney ewes should be a passing phase. The fine points of quality are not important compared with the necessity to run enough ewes to achieve utilization and its attendant development, thereby producing income which can be measured in terms of money per acre.

Farm Layout

Grazing management is closely tied to fencing and roading layout. It is proposed, therefore, to deal fully with the layout angle first, and then to discuss grazing management.

In 1947, there were eight large and ten small paddocks on the 840 acres, but unfortunately most of the timber and wires were rotten, and the fences were not much use. Only a small part of the farm could be reached with a horse and cart. Increases in stock were starting to show from 1951, and although stock increases should occur before money is spent on fencing, we were at a stage where fencing had

to be started as well. Roading has been carried out as needed. In the early stages, this consisted of simple bulldozing and small culverts; later, increased traffic required large quantities of metal in the prevailing wet conditions. Two substantial steel bridges have been built across the stream on the eastern side of the main block, and some smaller wooden structures have been erected. The large stream is as yet unbridged; it flows mostly in a wide bed of shingle and is too big an engineering job to have reached top priority as yet.

As stocking has been increased, and more rapid means of transport adopted, the matter of roading has become of increasing importance.

Fencing was at first mostly concentrated on renewing all the boundaries, and then on the main paddock subdivisions. During this latter stage, some ideas on improved layout were being developed, and a few changes were made to give better working of stock, but, in the main, ideas on layout have grown as further subdivision has become necessary.

When we started fencing, few farmers, or at least few sheep farmers, seemed to appreciate that good layout can make the work of the shepherd much easier and more efficient, as well as obtaining that primary aim of subdivision, utilization of pasture.

After having tried various sorts of rotational and mob stocking, we are strongly in favour of set grazing of a sort. Subdivision is essential to grassland development and to the effective use of the labour force. It is most important that original layout should be capable of further subdivision and it is therefore necessary that, as far as possible, paddocks should be the shape of a sheet of paper. When bisected, they will then give two pieces the same shape as the original. The square paddock when cut in two is too long and narrow. The principle of fencing-off shady from sunny faces cannot be applied to "Ratahiwi" — the hills are small and irregular. However, this has not been any trouble as enough stock are put on to eat everything.

In the first round of subdivision, paddocks of 50 or 60 acres were made. At that stage, these sizes were acceptable, but as the number of sheep increased these paddocks were halved. Now a size of 20 to 25 acres seems better. Paddock size is not calculated as a fraction of farm size, and is not established in consideration of actual area. It is based on the belief that under set stocking it is preferable to have mobs of not much over 200 ewes during lambing and

docking and through to weaning. In wet conditions, much trampling is avoided, particularly as cattle can be wintered at two or three per paddock. Thus, rather more stock can be carried. Shepherding is much easier, particularly the jobs which entail mustering ewes and lambs. It is submitted that were 500 ewes being handled on 80 or 90 acres, serious tangles would occur at lambing time. Docking would be much harder also, with much more likelihood of injury to the lambs in yarding, and from crushing in the yard, as well as mismothering.

The woolshed on the main block has access from the road by a small and narrow paddock through which a metal road runs. From there, about a mile of fenced, internal road goes to the No. 2 sheepyards, and branching from this, another metal road runs through two small narrow paddocks to the other yards in the block. This latter road will no doubt eventually be double fenced. This basic layout simplifies movement to and from anywhere on the farm for men and stock, and has enabled the two partners to keep up with a four-man gang at shearing and crutching. A further lane and a set of sheepyards are to be constructed on the western side of the block across the large stream. A holding yard wherever several paddocks join is preferred. This is most valuable for docking as sheep run freely into a permanent structure, and a small portable pen is then set up for crushing and docking. During lambing, these yards are used for mothering, and at all times the yards are used for marshalling mustered mobs before driving. Most paddocks can be mustered in more than one direction, which means that sheep of one class can be mustered easily, even if their several paddocks are not all in one block.

Grazing Management

For reasons of pasture and stock thrift, as well as for the economy of labour, stock is not mobbed. Successful set grazing of the kind practised requires much more mental effort than any rotation or mobbing, as it is necessary to project pasture growth and consumption ahead to minimize the amount of shifting of stock. "Set stocking" is not a very accurate term for the method used which is quite different from that of research stations such as Te Awa, where a fixed number of sheep is maintained all the time. Management is first and foremost flexible. There is always a better way of doing anything, and day-to-day grazing management must be played by ear.

The present approach has developed from experience over the years, so an historical record of management would serve no purpose. There must be a period when part of a farm is undeveloped and utilization of this part is more difficult, but not many years should elapse before all the land pulls its weight.

A year's management, beginning at the end of June, will now be examined. As the ewes are crutched at this time of the year, they are counted into the paddocks in which they will lamb. If the paddock has too much grass, it is stocked more heavily, and some surplus hoggets are held in another one. The counting is done after careful revision of past results and bearing in mind the actual areas involved. Numbers change each year, as stocking is increasing at half a ewe/acre per annum. Perendale ewes are in two groups, two-tooths being kept separate. The Romney ewes consist of four groups. The two-tooths are run separately from the four-tooth to four-year age group, and there are some of each age mated to the Southdown. At times some five-year ewes are run, and these are kept apart. It has been found necessary to keep these groups for purposes of preferential grazing. The two-tooths must be grown as well as possible, but should not be overfed at lambing; they are least affected by pre-lambing metabolic troubles. The low-mouthed, five-year ewe, on the other hand, is easy to fatten in the autumn, but is much more of a sleepy sickness risk. Two-tooth ewes are kept as handy as possible for easy shepherding at lambing.

The exact placing of each group at this time is worked out well ahead — this is much easier than autumn management. Sometimes there are a few surplus cattle still held into July. Straw is non-existent on "Ratahiwi" but straw, or even the white stems of autumn grown Yorkshire fog, can predispose to bearing trouble. Where autumn growth has not been fully controlled, cattle must help to clean up the fog stalks, and it is fine judgement to know when to sell so that the remainder are able to go right through. Cases of bearing trouble have been under one per thousand ewes over recent years.

No reserves of feed whatsoever are kept, and hay is never fed. No crops have been grown since 1953, and the stock rely on fresh-grown grass all the year. Some of the stock would be sold in preference to their starving, but this has never been necessary. Often ewes have been bought in winter. The amount of feed available reduces gradually

during July, but under set-stocking this does not do any great harm to the ewes.

During July, the ewe hoggets are closed up a little to their wintering of about nine-and-a-half/acre on two larger paddocks. This last tightening up gives a little more space for the ewes. A few cattle are moved round as necessary, and they finish up at two or three in most paddocks. During July, August and September, fair utilization of the rushes common on the land is observed.

Fast growing pasture is much higher in protein than any other, and therefore the amount of bulk required to maintain a ewe reasonably is not great. This is a help in preventing bearing trouble, as the ewe is not overfilled when heavily in-lamb. The feed position is watched constantly and a few ewes are shifted from one paddock to another when necessary. The fenced roads and extra yards are a big help with this job.

Ewes are set-stocked through the main run of lambing, starting late August, and then all those without lambs are shedded-out. Dry ewes are stocked heavily where gorse is being eliminated, so that they are no heavier than wet ewes at weaning. Late springers are brought to the handiest paddocks and the occupants of these drifted out to replace the ewes which have been brought out from those with lambs. Because of arthritis, docking cannot be carried out until lambs are quite big. The lamb requires immunity somewhere between three and four weeks, and substantial damage occurs if it is docked too soon. When looking for casts after docking, it is easy to watch the feed, and a few ewes or cattle can be drifted through a gate as indicated.

Weaning has, in the past, been started in November, but now that there is ample feed it is done during December. Down cross lambs are drafted from the mothers and about 35% are sent to the freezing works. Romney lambs are all retained; 30% could be drafted but they are held to eat grass. Cattle numbers will be doubled by purchasing in December. The matter of weaning feed cannot be reconciled with the old-fashioned idea of long spelling before weaning. If paddocks were shut up for two weeks, feed would become coarse, and large numbers of cattle would be needed to hold it. Organization at this time can be likened to playing chess on a crowded board. There are no empty paddocks, so, on the first day, lambs in at least two paddocks must be weaned. Lambs are put in one of the paddocks, ewes in the other. Later it becomes easier, and some spelling of up to seven days is done to let the grass move.

As far as possible, ewes are set-stocked at a rate of 10 to 15/acre. The cattle are moved round if necessary, bearing in mind that many cattle running with the lambs will eat the best feed and thus adversely affect the lambs.

Some mobbing of ewes is unavoidable while they are being sorted, but they are set-stocked as much as possible during the summer.

From December to April, the risk of ill-thrift on very soft feed is present. Lambs will do well when they have sufficient choice so that they eat their fill. This is achieved by allowing soft pastures to gradually grow ahead of the requirements of the lambs. If control occurs, intake is voluntarily restricted and instead of the lamb eating enough for itself and its parasites, the major part of the restricted intake is appropriated by the worms, and the lamb gets only what is left over. By late January, or early February, some of the paddocks on which the lambs were weaned will be coarse. The occupants are shifted to a short, but actively-growing pasture, on which ewes have been running, and ewes and some cattle are put in to clean up. Some effort will be made to spell for a few days but this is not important.

Replacement Perendale ewes are bought in January, and also Romney ewes when there are not enough two-tooths for the required increase of the flock. These provide useful grass-eating ability.

During February, half the remaining Down cross lambs are drafted, and in March some of the Romney wether lambs and most of the remaining Down cross go off. Some fat cattle will usually go off about March or April.

By mid-March, the ewes will be sorted for tupping, and they are left set-stocked at 10 to 15/acre, with 1% of rams being put out about March 24. The rams are not changed during tupping. This date is set more to coincide with the expected spring weather and growth pattern than to match any theories on maximum lambing percentages, and there is no desire to have all the ewes lamb in one week. The one ram per hundred ewes has been found adequate, although an endeavour is made to have mobs of 200 or more ewes, so a mob is not dependent on one ram. Rounding up during tupping is a waste of effort.

More lambs go off during April, May and June as feed indicates, and each time they go the ewes are spread a little. The surplus ewes are mostly low-mouthed five-year-olds, and about 25% are fit to breed again. The culls are kept to eat grass until early May when they go to the freezing works, and those with teeth are mated to the Southdown early in

March. They are then kept until June and either sold or are available if more ewes are required.

During later autumn, hoggets are reduced from weaning rates of about 10 to 8/acre.

Thus, in mid-winter, all the ewes are very fit and active, but not overfat. The ewes are bred to have a good constitution. As fertility builds up, the principle of spelling paddocks for any length of time is not satisfactory. Spelling after DDT applications has been found very difficult, and damaging to the pasture. Some officers in the Department of Agriculture like to see the best lambing paddocks allowed to go rank through winter, but our opinion on this matter differs. In those parts of New Zealand where land cannot waterlog in winter and early spring, conditions might vary this view, but most of our country becomes very wet at times, especially the stronger, bottom land which is so handy for lambing.

On the old stocking level of under 3 sheep/acre, which is a very bare subsistence level for the farmer, nothing much happened when paddocks were closed up for a month or so in the dormant period, but, in our case, the position has changed. Growth used to stop early in April and start again in October, but now an appreciable lift can be observed even in late July. If paddocks are shut up for any period, the ryegrass and Yorkshire fog quickly become quite long and, when sheep are put in, these grasses go flat and quite a fraction is trampled in. As grazing progresses, one is left with the white stems of fog in clumps — ideal for causing bearing trouble. If paddocks were spelled during winter there would be quite a bit of feed in August, but the spelled paddock appears to suffer badly from the inevitable dry periods which come in spring as the bottom is opened. Slugs and porina, aided by shading, have done much damage to the clovers. Continuous grazing appears to give much better stock thrift and more vigorous pastures.

Results

The sheep in 1947 were hungry; today their thrift, wool weight per sheep and general health have improved steadily and are still rising.

Wool production was about 12 lb/acre and of poor quality; for the last three years it has exceeded 60 lb/acre — last year, 66½ lb. It now reaches the top price group at Napier wool sales.

From store farming progress has been made to the stage where now all surplus stock is fattened.

From a base level of just over 80%, the lambing percentage (Romney ewes) increased steadily to 101% in 1962 and 1963, dropping to 92% in 1964. Perendales average 108 to 110%, but the figure was lower in 1964. Very bad conditions in the spring apparently accounted for the drop. Five per cent of dry-dry two-tooths are anticipated and usually discarded; under 2% of older ewes are dry-dry. These figures were not exceeded in 1964.

The teeth of sheep on "Ratahiwi" were never good. At first, all five-year ewes were unsaleable as breeders, but now one quarter have enough teeth to last another year.

Despite the gloomy statements which one hears about the effects on health of stock resulting from heavy numbers of animals per acre, our sheep are stronger and healthier now than they ever were before. The reason for this is really quite obvious. The old, low-grade pastures produced a sparse growth which also had a low content of nourishment, and the grazing animal had to eat a big bulk to get enough protein. Healthy and fast-growing pasture plants are much more attractive to the sheep and their nutrient value is good. Te Awa Station (Grasslands Division, D.S.I.R.) has increased protein from 14 to 21% dry matter as pasture grows better. Also, each bite taken by the sheep contains more grass blades and clover leaves than could ever be picked up at once fifteen years ago. Our losses are low, under 2% ewes through winter and spring, and very few hogget deaths.

The standard diseases and parasites have always been present. The dosing programme is to treat some lambs at weaning if necessary, and all lambs once or twice in autumn. Two-tooth ewes are dosed before March shearing, resulting in better thrift and a reduction in shed-staining of wool. Thiabendazole only is used. Ewes are vaccinated for pulpy kidney only, and rams for brucellosis. More vaccination and drenching is not envisaged as being necessary.

As production per sheep has been increasing, it follows that production and therefore income per acre has stepped up rapidly. At the moment, gross profit on sheep and cattle plus wool sales is about £25 per acre, and that on a low cost structure. Not much money is being wasted on wages, and no agricultural work is being done.

Labour Utilization

The two partners have had no trouble doing the regular work up till now, and have done all dagging, lamb and hogget crutching. Contractors have done most of the fencing, and all shearing and ewe crutching. The matter of utilization of labour has been studied, and some points that have added to efficiency may be mentioned.

The shearing pattern is to shear all ewes, rams and Romney lambs early in January, when lambs are weaned and ewes dry. This is much easier; casting is no trouble during winter or while docking is in progress. Incidentally, the wool is free of vegetable matter.

Transport of personnel round the farm is most important. The horse is too slow and was dispensed with years ago. In the present system, each permanent worker has a motor cycle of suitable type, used for all shepherding and mustering except the lambing beat. The cycles go almost anywhere, are fast and cheap to run, and can often cross swollen streams on a 9 in.×2 in. plank 10 or 12 ft long. A wheel tractor is used for each lambing beat, with transport box for live sheep at the back, and a front-end tray for dead ones, plus a tin trunk for lambs. A ewe is never asked to take her lamb in the paddock after handling — there are plenty of yards round the farm. If a track bogs or threatens to do so during lambing it is metalled in dry weather. Trucks can travel to the outlying sheepyards in all weather.

No time is wasted on regular shifting of sheep. By justifying oneself for what one does, many traditional chores are eliminated or altered. No cow is kept.

There is no doubt that the main economies of labour are tied to the close subdivision, plus plenty of yards, and fenced stock routes with ample roading and metal where required.

Development Work

The basic pasture development followed ordinary lines. At first, only part of the farm was topdressed, as there was neither the finance nor the managerial ability to cope with the increase of stock that would have been involved. In the first few years, 330 acres of the easier country was giant-disced, the clock area being just over two hundred acres. Some choumoellier was grown but the crops were poor. Then grass to grass was tried and found more successful. The absence of cropping has been a major factor in stepping

up carrying capacity. As one builds up soil fertility to a degree which is embarrassing, a crop is the best way of cashing in on it. Then one starts building up under grass. Grain is the best way of reducing fertility, but fodder crops are not bad, so reasoning from this, why crop infertile land? Crops would probably grow quite well now, but utilization is difficult in winter, and continuous grass growth has been achieved.

Taxation

Taxation, admittedly, is high, but New Zealand is a welfare state and total taxation, therefore, cannot be much reduced. It is more important to look at what income remains, than at what is paid in tax. A man with three dependants, earning £3,200 per annum, has three-quarters of his income left for himself; and by the time it rises to about £8,400 he still has half of it. Approximately £4,000 per annum clear is quite good at that stage. It is possible to have all sorts of development expenses allowed when building up a farm (or any undertaking) which has the effect of providing incentive for further development.

Conclusion

Broadly, our approach to farming has been to give the land what it needs, subject to budgeting of expected results indicating at least long-term profitability. We have been able to build a new woolshed, two steel bridges, miles of metal roads, as well as buy 300 acres more land and finance the extra livestock. There has been an investable surplus as well.

Cash budgeting is most important as it is no use spending all one's funds making the grass grow and having no money for extra stock. Part of "Ratahiwi" was developed at a time when funds were limited. Very few farmers would be sufficiently capable to handle the sudden increase of stock required from putting 5 or 6 cwt of superphosphate plus clover over all a farm at once. The parts of the farm which were regrassed are not now significantly better than those oversown only. The costs of sowing, including £3 per acre stumping were considerable, but there was a quick lift in growth from new grass, and the ground was certainly smoothed out.

The key to our development may be expressed in one word — utilization. All the grass grown is used as it grows by the grazing animal; thus it grows faster. With the rates

of stocking the animals are topdressing the land at a much higher rate than it could be done from a bag; in particular, the amount of nitrogen they supply would be equal to at least a ton of sulphate of ammonia per acre, per annum.

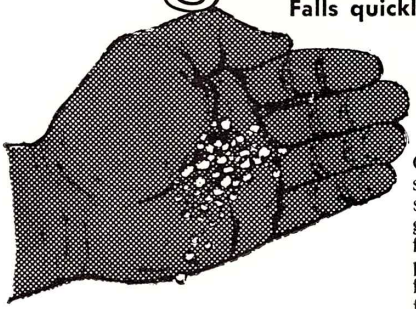
Development is a process which can never be completed. We see no insuperable barrier to further large increases in stock numbers. The pastures are still increasing in vigour; the sheep are happy. Some drainage is envisaged at costs that will be fairly high.

Grasslands Division, D.S.I.R., are doing very good work on winter-growing legumes as well as ryegrass so when these come into use it will be necessary to examine the benefits of re-grassing or re-oversowing.

We are convinced the opportunities in farming are good; the future is unlimited, and it is a very pleasant occupation.

Challenge's *new* DDT SUPER *it's granulated*

Falls quickly through to soil surface



MINIMUM PASTURE WITHHOLDING PERIOD

NO PERMIT NEEDED

ECONOMICAL AND EASY TO USE

Challenge's DDT Super does not stick to dry foliage but falls to soil surface; quickly reaches down to grass roots. With risk of residues on foliage reduced to a minimum, the pasture withholding period is 4 weeks for dairy cattle in milk and 2 weeks for sheep and other cattle. Granule form eliminates drift — neighbouring properties will not be affected by residues.

Each granule of Challenge DDT Super has its correct proportions of Superphosphate and DDT Powder. Combines top-dressing and pasture control in one simple operation. May be used by all types of ground or aerial top-dressing machines.

CONTROL PASTURE PESTS THIS SIMPLE EFFECTIVE WAY WITH CHALLENGE GRANULATED DDT SUPER WHICH CONTAINS 20 lb. DDT P.P.I. PER TON

KILLS GRASS GRUB
when evenly applied at 2 cwt. per acre. Costs only 11/5d. per acre more than, normal Super Phosphate.

GRASS GRUB
for up to 3 years.

PORINA CATERPILLAR
(Subterranean grass caterpillar) for up to 2 years.

CATTLE TICK
for up to 12 months.

ARMY WORM
in early stages of infestation.

CHALLENGE

Granulated DDT Super

POISONOUS — NOT MORE THAN 1.3% D.D.T.

Manufactured only by the N.Z. FARMERS FERTILIZER CO. LTD.
Incorporating the Challenge Phosphate Co. Ltd. and the Kiwi Fertilizer Co. Ltd.
AUCKLAND — MORRINSVILLE — NEW PLYMOUTH

MANAGEMENT AND FINANCIAL ASPECTS OF HIGH SHEEP STOCKING RATES

N. WATSON*

CURRENTLY there is much interest in raising production by increasing stocking rates to very high levels. This applies to dairy as well as sheep farms. The formula prescribed, in its simplest form, is "more stock + more fertilizer = more production = more profit". Suckling at Te Awa, Inglis at Woodville, and others have demonstrated that it is possible, by applying this approach, to push sheep carrying and production to very high levels even on hill country. In dairying, the results are even more spectacular and work at the Waimate West demonstration farm and by a number of farmers in South Taranaki and Southern Hawke's Bay, has raised dairying production horizons to the level of 1½ cows and 500 lb of butterfat to the acre. Furthermore, the studies of Graham and Candler at Massey have shown that increases of this sort are likely to be highly profitable for many dairy farmers.

Despite good work by Wright, the economics of the situation in sheep farming are by no means as clear. It is therefore proposed, in this paper, to examine such evidence as is available in an attempt to throw more light on what happens to production and financial returns when sheep stocking rates are pushed to high levels. This will be done within the context of uncultivatable hill country using, as the main source of information, Suckling's findings at Te Awa (*Sheepfarming Annual 1964*, p. 18). Reference will also be made to work done some years ago by Walker at Ruakura and to the writer's observations of results on a number of farms over a relatively long period of time.

Considerable use will be made of tables of figures. This is unavoidable but the aim in doing so is to establish patterns and trends relative to the problems dealt with rather than to attach too much importance to the figures themselves. It is also necessary to stress that the matters dealt with are extremely complex and in order to handle them some aspects will deliberately either be ignored or oversimplified. Because of the nature of the problem it is also necessary to introduce some "tools" which will be used to help in the analysis and discussion.

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The Tools of Analysis

These tools are four in number and they differ from what are normally thought of as farm tools in that they are merely ideas — in reality very simple ideas but, nevertheless, essential to organized thinking.

They comprise:

(1) The "fixed and variable cost concept".

(2) The idea of "gross margin" as a measure of return.

(3) The well-known but little understood "principle of diminishing returns".

(4) The approach of "marginal thinking".

The Fixed and Variable Cost Concept

This is based on the simple fact that, in making any change to an existing farm organization, some of the *annual* farm costs will remain fixed and others will vary with the change made. In reality there are, at the extremes, the two classes of costs, one which will always vary with the change made, and the other which will always be fixed. In between there is another class which may either be fixed or variable according to the particular proposal and farm situation under consideration. This can best be illustrated by an example of increasing sheep numbers by, say, 500 ewes. The annual variable costs in this instance will include: extra outlay for rams; shearing, crutching and woolpacks; veterinary expenses such as drenches, vaccines and dip; interest on extra capital outlay on the stock; and ewe depreciation costs. The fixed costs — that is, those which do not change — include interest or rent on the land, rates, insurances and depreciation. Between these two classes are the items which may or may not vary according to the farm situation, and these include labour costs, feed production costs, and perhaps additional annual expenditure for woolshed and yard additions.

Gross Margin

This is the average revenue from a given farm activity less the variable costs associated with it. Thus, when putting on an additional 500 ewes, the gross margin per ewe would be calculated as follows:

Per Ewe (Av. 1960–64 prices):

Wool 11 lb at 36d. net	33s. 0d.
Lamb net	45s. 0d.
Total revenue	78s. 0d.

Less Variable Costs:

Ewe depreciation	7s. 6d.
Interest	3s. 6d.
Ram costs	2s. 0d.
Shearing, etc.	3s. 6d.
Veterinary and farm stores	1s. 6d.
Labour costs	—
Feed production	—
Other	—
Total costs	18s. 0d.
Gross margin per ewe	60s. 0d.

The Diminishing Returns Principle and Marginal Thinking

The diminishing returns principle is a natural law which covers the fact that in adding livestock (or any other productive factor or combination of factors) to the farm, the returns obtained are not constant but vary at different levels of production and ultimately diminish to a point where no extra return is obtained. This principle is a most important one and, as most of this paper is based on it, further explanation is required.

Figure 1 illustrates the diminishing returns principle. It also illustrates in a very general way, the writer's observations of what happens, under present technology, to production on hill country as development is effected and sheep numbers are increased. It will be understood, especially at the higher levels, there is some variation from farm to farm according to practices, management efficiency and the class of land.

It is perhaps necessary to mention also that the ewe figures per acre are sheep ewe equivalents. Any cattle run are additional to this and can be assumed to be in "normal" proportions or ratios. Also, development is rarely effected simply by putting on extra stock. It is therefore assumed in this diagram that the stock figures include the "normal"

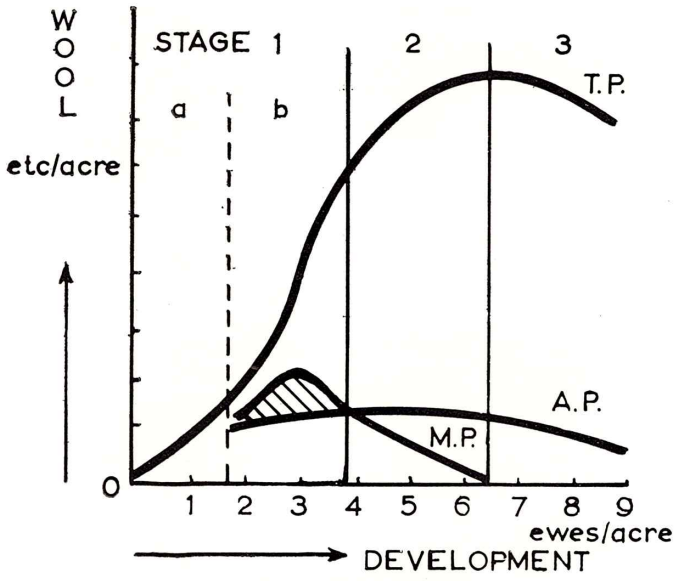

FIG. 1: *Diminishing returns principle.*

complementary inputs, such as manure, labour and management, necessary to the level of stocking.

The line T.P. represents total production per acre and it is this on which attention should first be focused. It will be observed that it is not a straight line as would be the case if returns were constant. Instead it first curves to the left, then to the right, and finally downwards. In fact, three distinct stages can be distinguished and these are marked at the top 1, 2, and 3. In Stage 1, after a slow start up to 2 ewes per acre, T.P. is increasing at an increasing rate for every extra sheep carried. This is simply a reflection of the fact that the sheep thrive better with the improvement in pasture quality and quantity as the soil fertility cycle is initiated and gathers momentum. In Stage 2, T.P. continues to increase but at a diminishing rate, and, in Stage 3, T.P. actually decreases as extra ewes are put on. The reasons for these trends in Stages 2 and 3 are not altogether clear but will be discussed later. It is sufficient at present to note that the pattern is in conformity with the law of diminishing total returns.

The second graph line M.P., represents marginal production and this introduces the fourth tool which is the idea

of marginal thinking. That is to say, a shift is made from thinking in terms of total production itself to what is added to total production at each step in increasing carrying capacity. The emphasis is on the word *added* as, in effect, marginal means added. Thus, considering the M.P. graph line, as development proceeds and stocking is increased from, say, 1 to 2 ewes per acre, it may add 10 lb of wool per acre to total production. From 3 to 4 ewe equivalents per acre, it may give an increased amount of 15 lb/acre. Still later, with the increase from 5 to 6 to the acre, the increase in wool output may be down, perhaps to 5 lb/acre, and from 6 to 7 ewes nothing is added to total production per acre.

The third graph line A.P. represents the average production per ewe at each level of carrying capacity. It will be noted it rises to a maximum at the end of Stage 1 about the level of 4 ewes/acre and then declines progressively. It is this factor, average production per ewe, combined with stocking rate per acre which really governs the total and marginal production patterns. In particular, it should be noted that, whether average production per ewe is increasing or decreasing, it is the production of all sheep at that level that is affected and not merely the production of the last sheep put on.

Figure 1 covers the physical production situation only. However, it may also be used to make several generalizations in respect of the profitability of intensifying sheep production. When considering profitability, it is again necessary to think marginally — that is, to think in terms of added returns and added costs at each stage as sheep numbers are pushed up. Thus the first point becomes clear that it is unprofitable to push stocking into Stage 3 where total production declines, for the simple reason that extra costs would be incurred for a negative return.

On the other hand, clearly Stage 1, or at least, the latter part of Stage 1, where increasing returns take place, is likely to be a highly profitable phase. This is because marginal production for each ewe put on is greater than average production. Thus, if sheep production is profitable at all, it is almost certain to be profitable to intensify, at least as far as the beginning of Stage 2 — that is, until marginal production equals average production.

The profitability of Stage 2 will depend on the situation on the particular farm — the class of land, the level of farming efficiency, the size of farm, the labour situation, the taxation levels, and a host of other factors. Nevertheless,

some generalizations can be made. The first is that, in direct contradiction to what has often been said, it does not pay to increase production per acre right to the maximum level. It is true that increased production spreads fixed overheads and thus lowers average *fixed* costs. But as demonstrated earlier in this paper there are variable costs involved and somewhere along the way in Stage 2, before the maximum physical production potential is reached, the marginal returns will fall to a point where it will not be economic to proceed further, that is, at this point added returns will not be sufficient to meet the added costs involved in going further. Thus it becomes clear that profit is greatest at some point *before* maximum physical production per acre is reached and the actual point will vary with the particular farm. In this respect it can be said that, in theory, sheep profits are maximized if production is intensified to the point where marginal returns just cover marginal costs. In practice, farmers are faced with risks and uncertainties arising from varying prices and varying seasonal conditions. This means that it is not always prudent to push production quite this far.

It is also necessary to consider that, at the higher levels, there may be other more profitable alternatives to that of further intensifying with sheep. For example, while at the lower levels of development sheep may be more profitable than cattle, at the higher levels the situation may change in some circumstances and cattle become more profitable than sheep.

There is also the alternative of buying additional land — that is, relatively unimproved land. After all, why pursue rapidly diminishing sheep returns on the original holding if increasing returns can be obtained by buying in additional land? But, of course, the difficulty is that suitable land for this purpose is becoming more and more scarce and costly. This means that it will be increasingly necessary in the future for farmers to push on up the scale of intensity in sheep farming. This, in fact, is the main justification for this paper which deals essentially with what happens at the higher levels of sheep stocking.

The Information from Te Awa

In the *Sheepfarming Annual 1964*, Suckling presented information from the Te Awa graded stocking rate trial carried out during the five years 1959–60 to 1963–4. Included in his paper was a tentative financial analysis made by

Watson. It is now proposed to re-examine the Te Awa information using the tools which have been outlined. To begin it is necessary to recapitulate the essential features of the trial.

The Te Awa research area is well known to many farmers. It comprises reasonably representative uncultivatable hill country at medium altitude and under moderate rainfall conditions. The trial was designed to compare stocking rates of 3 to 7 ewes to the acre with and without cattle all other factors being kept constant. It should be noted in particular that the whole area had the same fertilizer treatment. This was twelve annual dressings of 2 cwt/acre of superphosphate prior to the trial commencing, followed by 6 cwt/acre for two consecutive years, and then 2 cwt/acre annually in the last three years. Two applications of DDT were made during the five years of the trial to control grass-grub and subterranean grass caterpillar. Paddocks are small, varying from 4 to 6 acres, and the grazing pattern essentially one of set stocking. Replacement ewes were brought in as two-tooths and cast-for-age at 5 years. All lambs of both sexes went off the property following weighing, weaning and shearing in late December. In the sheep plus cattle section, dry cattle were used and these were brought in as required to facilitate full utilization of feed. Thus cattle numbers varied with sheep stocking rate and season of the year.

Physical Data

The physical information is given in Table 1. It should be explained that the figures for the 7 ewes/acre rates are not fully comparable as they were taken from other sections of the trials at Te Awa and cover only three of the five years. However, they are sufficiently good to indicate trends in production. The 6 ewes/acre figures have been derived on a proportionate basis from the 6½ ewes/acre figures given by Suckling. This adjustment is essential to analysis.

The information in the table should be looked at marginally — that is, it should be considered from the angle of the addition to or subtraction from production with each change in stocking rate. First it will be noted that stocking rates go up equally in steps of one ewe/acre. Next it will be seen in Column 2, that the mean liveweight of the ewes drops rapidly as stocking rate increases. This represents, overall, a loss of 13 lb for the ewes without cattle and some 20 lb for those with cattle. Further, most of this drop occurs between 4 and 6 ewes/acre.

TABLE 1: RESULTS OF TE AWA STOCKING RATE TRIAL
1959–64
PHYSICAL DATA

1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*
Stocking Rate per acre	*Liveweight of Ewes (lb)*	*Length of Teeth (in.)*	*Lambing (%)*	*Lamb Wt. (weaning) (lb)*	*Wool Weight Ewe (incl. lamb) (lb)*	*Wool Weight/ acre (lb)*	*Ewe Deaths (%)*	*Ewes assisted at Lambing (%)*	*Footrot Incidence (%)*
WITHOUT CATTLE									
3	120.9	0.43	111.0	55.6	14.8	44.4	2	12	22
4	123.9	0.33	103.2	53.9	14.5	58.0	4	12	15
5	115.1	0.26	98.9	50.4	13.8	69.0	4	10	7
6	111.9	0.19	95.0	49.2	13.1	78.6	6	15	8
7	107.1	0.16	95.5	47.6	11.2	78.4	2	3	6
WITH CATTLE									
3	129.0	0.31	115.2	59.3	15.8	47.4	3	17	20
4	127.0	0.23	108.4	56.7	15.6	62.4	7	13	9
5	119.2	0.20	102.2	51.5	14.9	74.5	4	8	4
6	111.7	0.13	100.5	50.2	13.6	81.2	3	10	3
7	109.0	0.12	92.9	49.2	11.6	81.2	4	6	1

Note: The 6 ewes per acre figures in columns 2, 4, 5, 6 and 7 have been adjusted from Suckling's 6½ ewes per acre figures for analysis purposes. In the other columns no adjustments have been made.

Column 3 deals with teeth wear measured at 5 years of age, and it will be observed that wear is progressively greater as stocking rate is increased.
Thus, initially, at 3 ewes/acre mouths are good but at 7 ewes/acre they are in the low or broken mouth category.

The lambing percentages in Column 4 start initially at a high level but these fall fast as stocking rate increases and, overall, represent a drop of 15½% and 22½% respectively.

Column 5 gives weights of lambs at weaning and these represent an overall drop of 8 lb without cattle and 10 lb with cattle. The weights at 3 ewes/acre indicate good store lambs while those at 7 ewes/acre could be described as indifferent medium lambs. It will also be noted that the lambs from the section with cattle were heavier in each case, especially at the lower stocking rates. This indicates

a complementary relationship of some kind between the cattle and the sheep. A similar effect is seen in the lambing percentages and the wool figures.

All of the factors examined so far — ewe liveweight, teeth wear, lambing percentage and lamb weaning weight — show interesting and meaningful trends, but the most interesting are the wool figures in Columns 6 and 7. These need somewhat more detailed consideration and for this purpose have been shown separately in Table 2. The marginal changes in production both per ewe and per acre are also shown in this table. The wool per ewe figures, it should be explained, include crutchings and also lambs' wool. Note that in both cases the overall drop in wool per ewe is about 4 lb. Also, as the marginal figures show, the drop is progressively greater with each step in increased stocking.

While wool per ewe diminishes with increased stocking rate, total wool per acre increases, at least to 6 ewes to the acre, after which it declines. The marginal per acre figures also behave as can be expected in that increases are at a decreasing rate and eventually become negative between 6 and 7 ewes/acre.

It becomes clear from these wool figures that the stocking rate work at Te Awa encompasses Stage 2 and 3 of Fig. 1. In fact the figures fit almost perfectly. Total wool per acre is represented by the line T.P., marginal production per

TABLE 2: WOOL PER EWE* AND PER ACRE

Stocking Rate per acre	*Per Ewe (lb)*			*Per Acre (lb)*	
	Ave.	*Marginal Change*		*Total*	*Marginal Change*
WITHOUT CATTLE					
3	14.8			44.4	
		—0.3			+13.6
4	14.5			58.0	
		—0.7	—3.6		+11.0
5	13.8			69.0	
		—0.7			+ 9.6
6	13.1			78.6	
		—1.9			— 0.2
7	11.2			78.4	
WITH CATTLE					
3	15.8			47.4	
		—0.2			+15.0
4	15.6			62.4	
		—0.7	—4.2		+12.1
5	14.9			74.5	
		—1.3			+ 6.7
6	13.6			81.2	
		—2.0			+ 0.0
7	11.6			81.2	

* Includes crutchings, bellies and pieces plus lambs' wool.

acre by the line M.P. and wool per ewe by the curve A.P. or average production. No information is available on differences, if any, in wool style and quality at the different stocking rates.

In the physical data just discussed, it is clear that all aspects of production per ewe fall off quite steeply after the 4 ewes/acre level is reached. Production per ewe, together with stocking rate itself, are the crucial things governing the total and marginal production patterns and, ultimately, profitability. It is therefore important to establish why production per ewe decreases at these levels. Does it result simply from insufficient feed to maintain high production? Or is it due to other factors associated with the intensity of sheep stocking, such as disease build-up, or reduced opportunity for the sheep to select their feed, coupled with such effects as trampling, pugging, wasting and fouling of pastures? There is as yet no clear answer to this but it would seem to result from a combination of the factors mentioned and not to be just a simple feed problem.

The information as far as the disease factor is concerned is worth commenting on. It is commonly thought that, with sheep stocked at high levels, there is a build-up in disease problems and this is certainly some farmers' experience. However, at Te Awa, as shown in Table 1, the incidence of footrot is very much less at the high stocking rates. Also no sleepy sickness troubles were experienced at any level of stocking and salmonella has been troublesome only on one occasion immediately after a new flock of two-tooth ewes was taken on to the area. The story could, of course, be quite different on a full farm scale with larger mobs of stock and the inevitable periods of high concentration of stock. The ewe deaths, also given in Table 1, show no pattern and were about normal at all levels of stocking. Worm counts were taken in the ewes for the last two years of the trial but unfortunately not in the lambs. These counts indicated a build-up in worm infestation with increase in stocking rate but apparently not to critical levels.

Increased competition for feed and lack of opportunity, especially for lambs, to select their feed is probably a major factor influencing output per sheep at the higher stocking levels. Trampling, wasting and fouling of feed would also appear to be limiting factors, at least under conditions of heavy wet soils although these wet soil conditions did not apply at Te Awa.

In this respect it is interesting to note that with 7 ewes/acre wintered and 100% lambs docked, some 14 animals/

acre are voiding dung and urine over the spring period. This is a good thing for soil fertility but could conceivably, at periods, influence palatability or acceptability of feed. Also with 14 sheep moving about each acre there are 56 cloven feet at work in trampling, wasting and fouling of feed.

The Comparative Financial Returns

The physical production information from Te Awa needs interpretation in financial terms to bring it together and make it more meaningful. For this purpose the "gross margin" tool is used together with prices representative of the five years, 1960–64 inclusive. These prices are all net of selling charges:

Wool: 39d./lb with no variation for stocking rate.
Lambs: 40s. down to 28s. according to weaning weight.
Cast-for-age 5-year ewes: 40s. to 25s. according to teeth wear.
Two-tooth ewe replacements: assumed bought at 65s. a head.
Variable costs have been deducted for:
Shearing (double), crutching and woolpacks.
Ram costs.
Vaccines, dip, etc.
Interest on money in stock.
Ewe depreciation.

Table 3 gives the resulting gross margins per ewe and per acre. In both sections of the trial it will be noted that the gross margins per ewe decline very markedly. However, the gross margin per acre increases to six ewes before it drops.

But the most significant information is the marginal increase per acre given in the last line in each case. This continues to increase up to 6 ewes but, it should be noted, at a rapidly diminishing rate, especially between 4 and 5 ewes. From 6 to 7 ewes it will be observed there are negative amounts of 2s. 6d. and 11s. respectively.

It is helpful, in drawing inferences from these figures, to remember that the marginal per acre figures disclosed are the amounts available to meet any added costs over and above the variable costs already deducted. Such further costs would vary with the farm situation, but may include labour, feed production items, extra layout and equipment, and added return to the farmer for assuming the risks and

TABLE 3: GROSS MARGINS

	Ewes per Acre									
	3		*4*		*5*		*6*		*7*	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
WITHOUT CATTLE										
Wool	48	1	47	1	44	10	42	7	36	5
Lamb	40	0	36	1	30	8	28	6	26	5
Total per ewe	88	1	83	2	75	6	71	1	63	0
Less variable costs (not labour)	19	6	20	3	21	6	24	0	23	0
Gross margin per ewe	68	7	62	11	54	0	47	1	40	0
Gross margin per acre	205	9	251	8	270	0	282	6	280	0
Marginal increase in gross margin per acre			+45	11	+18	4	+12	6	— 2	6
WITH CATTLE										
Wool	51	4	50	8	48	5	44	2	37	8
Lamb	46	1	40	1	32	8	30	0	27	11
Total per ewe	97	5	90	9	81	1	74	2	65	7
Less variable costs (not labour)	20	0	22	6	21	6	23	3	23	6
Gross margin per ewe	77	5	68	3	59	7	50	11	42	1
Gross margin per acre	232	3	273	0	297	11	305	6	294	7
Marginal increase in gross margin per acre			+40	9	+24	11	+ 7	7	—10	11

management involved in increasing stock to high levels. In this respect the added return of 40s. to 45s. in increasing from 3 to 4 ewes/acre should more than cover any of these further costs and still leave a real profit margin. However, the situation at higher levels of stocking is much more doubtful unless costs can be kept to a minimum. Perhaps the most crucial factor is that of labour cost. Depending on the farm situation, labour costs range from nil to over 20s. per ewe, the higher figure being represented by the situation where an extra married man is put on at an annual cost of £1,000 for every 1,000 ewes. This is where Inglis has shown how costs, and especially labour costs, can be kept to a minimum and thus make it possible profitably to push development to higher levels of sheep carrying.

THE ROLE OF CATTLE

At this stage it is necessary to make brief reference to the role of cattle, first from the standpoint of their relationships to the sheep enterprise and, secondly, from the angle of their comparative profitability as an independent enterprise.

TABLE 4: DIFFERENCES IN GROSS MARGINS PER ACRE WITH AND WITHOUT CATTLE

	Ewes per Acre									
	3		*4*		*5*		*6*		*7*	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
With cattle	232	3	273	0	297	11	305	6	294	7
Without cattle	205	9	251	8	270	0	282	6	280	0
Difference — increase with cattle	26	6	21	4	27	11	23	0	14	7

Table 4 gives a comparison of the Te Awa per acre gross margins with and without cattle. It will be noted the increase from cattle is about 10% at all levels of stocking. This comes entirely through the better thrift of the sheep disclosed earlier in the physical information.

The cattle policy at Te Awa is the equivalent of buying mature animals in the spring and selling mainly as stores in the autumn. As such it is not considered possible to do much more than break even financially in an average year after allowing full interest on capital and buying and selling costs. To the writer's knowledge, the information from Te Awa is the only experimental evidence available of the complementary relationship between cattle and sheep which exists or is thought to exist, at medium to high levels of sheep stocking. There is also, of course, a relationship of a somewhat different kind between cattle and sheep in the early stages of hill country development, more especially in high rainfall areas. Neither of these kinds of relationships can be discussed further here but it is neces-

TABLE 5: COMPARATIVE REVENUE FROM ONE UNIT OF FEED

Sheep (prime lamb):		
1 lb lamb @ 18d. per lb	1s.	6d.
⅓ lb wool @ 36d. per lb	1s.	0d.
Total	2s.	6d.
Cattle Fattening:		
1 lb beef @ 125s. per 100 lb	1s.	3d.
(At current price 150s. per 100 lb)	1s.	6d.
Dairy Cows:		
1 lb butterfat (cheese supply)	3s.	4d.

sary to make a brief comparison of the profitability of cattle and sheep as independent enterprises.

This can be done by first comparing the revenue per unit of feed used and, secondly, by making a comparison of the gross margins per ewe equivalent. Again prices representative of 1960–64 are used and all are net of selling charges. Table 5 gives the comparative revenue from one unit of feed. The physical information is based on observations and work done by Walker at Ruakura and by the Meat and Wool Boards' Economic Service.

The information in Table 5 is not completely realistic but it does serve to illustrate in a general and simple way that sheep make more profitable use of a given quantity of feed than do run cattle and also that neither in any way approach the returns from dairy cows. But, of course, no allowance has been made for costs and some market factors which affect the issue.

For these and other reasons, the second set of figures given in Table 6 is more useful. The gross margin for sheep is taken from the example given earlier and, it should be noted, the figures assume average management standard. Also no deduction has been made for labour costs which, in the case of sheep, can amount to anything up to 20s. per ewe. The cattle figures are based on steers of good average class, selling and replacing in the autumn. Further, all pur-

TABLE 6: COMPARATIVE CATTLE AND SHEEP RETURNS

Steers	*Purchase*	*Sell*	*Margin*	*Less Variable Costs (Interest)*	*Gross Margin per Head*	*Stock Conversion Factor*	*Gross Margin per E.E.*
	£	£	£	£	£		
Weaners/20 mon.							
(store)	19½	26	6½	1¼	5¼	1=3 E.E.	35s.
(fat)	19½	30	10½	1¼	9¼	1=3½ E.E.	50s.
20 mon./2½ yr:							
(store)	28	30	2	2	nil	1=4	nil
(fat	28	38	10	2	8	1=4½ E.E.	35s.

Comparative Gross Margin per E.E. from sheep — depending on labour, etc. = 60s. down to 40s.

chase prices are adjusted to costs landed home and all selling prices are net of selling costs.

It will be seen that sheep show a gross margin of from 60s. down to 40s. per ewe equivalent depending on the added costs for labour, etc. Cattle, on the other hand, return nil to 50s. per ewe equivalent depending on the class and age farmed and whether fattened or not. The figure of 50s. is for weaners fattened at 20 months and, as it is not normally possible to do this on hill country, this figure should perhaps be disregarded.

The indication from these figures is that sheep are more profitable to farm than cattle as the main enterprise, although the margin in favour of sheep does appear to have narrowed in recent years. Another factor against using cattle as the main source of income concerns the risks and uncertainties involved in drought and market factors. Further, with beef cattle, all the eggs are in one basket as there is only one product, whereas with sheep there are two. A still further factor influencing sheep versus cattle issues is the very much greater capital investment with cattle. This is illustrated in Table 7.

TABLE 7: COMPARATIVE INVESTMENT — SHEEP AND CATTLE

	Av. Value per Head	*Stock Conversion Factor E.E.*	*Investment per E.E.*
Sheep:			
Per breeding ewe	£2 15s.	1=1	£2 15s.
Cattle:			
Weaner steer	£19 10s.	1=3	£6 10s.
20 mon. steer	£28 0s.	1=4	£7 0s.

For the reasons given—greater profitability, more certain income and lower capital investment—it pays most farmers to run sheep as the major enterprise and to combine cattle, in the first instance, only as necessary for their production relationships. In this connection, early in the stage of development of the farm, with poor pastures, reversion factors and perhaps large paddocks, a high ratio of cattle is required (*i.e.*, early in Stage 1). Later, with farm development proceeding into Stage 1 (b) and the beginning of Stage 2, the ratio of cattle can be lowered to advantage — that is, assuming labour is not a limiting factor. In some instances in this phase, it is possible to almost dispose of cattle as has been demonstrated by Inglis, Linklater and

others. However, it is quite certain, from the Te Awa observations and also from farmers' experience, that, if cattle are disposed of entirely, sheep returns will suffer and weed and pasture problems will arise.

At a still later stage, as farm development proceeds further and as sheep numbers per acre are increased, marginal returns from sheep diminish to a degree where it will often pay to substitute extra cattle rather than extra sheep. This is especially so where labour is a limiting factor. It is also more especially true in high rainfall areas where droughts are not a factor and where summer pasture growth is high relative to the winter period. The writer cannot suggest any real answer to the problem of diminishing returns to sheep in the drier drought-prone areas. In these circumstances cattle are too risky and they do not fit into the seasonal feed pattern anyway. Thus numbers must be minimized and the emphasis at all stages remains on sheep. However, sheep production can only be intensified, profitably, to the point where marginal returns cover marginal costs, including a sufficient allowance for risks. Also, in these droughty circumstances, in order to safeguard stocking up to this level, it is necessary to introduce and use drought strategies. However, discussion of these strategies is beyond the scope of this paper.

Summary and Conclusions

In this paper an endeavour has been made to throw more light on what happens to production and returns as sheep stocking rates are pushed to high levels on hill country. This has been done because it is essential to have this information to guide not only the individual farmers in the front line of the industry but also the research and extension workers and the policy makers back at base.

In the course of presenting the paper some farm management tools have been introduced and their use illustrated. Farmers may find other uses for these in wrestling with their own farm problems.

A generalized model has also been set up illustrating what happens to sheep production at the different stages of farm development and sheep stocking rates using present technology. This is based partly on theory and partly on general farm observations and as such may be used as a basis for thinking.

Using this model, and the other tools of analysis, the Te Awa data has been re-examined in such a way, it is hoped, as to put this information in a rather different and more

realistic light from the individual farmer's viewpoint. This analysis has also shown that the Te Awa information fits the basic model at least for the stages it covers, namely, Stages 2 and 3. In particular, it seems to confirm:

(1) That, *using present technology*, there is a physical barrier to sheep production per acre at about 6 ewe equivalents to the acre.

(2) That diminishing marginal returns per acre start to occur much earlier than this, at about 3 to 4 ewes/acre.

(3) That there appears to be an economic barrier at between 4 and 5 sheep ewe equivalents unless costs, particularly for labour, can be kept much lower than is normal.

Following this consideration of sheep returns, the returns from sheep and cattle have been compared. From this it has been concluded that the role of cattle for most farmers should remain a subsidiary but nevertheless very important one in relation to the sheep — that is, important at all levels of development but more especially in the early and ultimate stages.

Finally, the writer is conscious of the possible negative effect of a paper which has, as its central theme, the diminishing return stage of sheep production. In order not to leave the wrong impression, it should be emphasized that diminishing returns do not normally occur until relatively high levels of stocking are reached. Most hill farms are at a very much lower stage of development and, consequently, can still move ahead with confidence to the earlier highly profitable increasing returns phase which has been defined.

For the relatively few farmers already in, or approaching the diminishing returns phase, it has been shown that the point of maximum economic return is some distance into this stage. The actual point is dependent on factors peculiar to the individual farm so that marginal analysis, and some degree of trial and error, need to be applied in each case. It is here, in individual farm situations such as these, that farm advisory officers may be able to help.

The industry also needs pathfinding and innovating farmers like J. Inglis, not too steeped in the traditional methods and also willing and able to explore the possibilities of breaking through the barriers. Further, more research is needed on this important matter, more trials on the lines of that at Te Awa, designed to clarify further

what happens to production and returns at high levels of stocking and the reasons for these trends. It is essential also that these trials be so designed and conducted as to provide the kinds of information necessary to sound decisions on individual farms and not just to clarify technical issues as has sometimes been the case. There is also need for positive research into ways and means of breaking through the present physical and economic barriers in sheep production.

Surely, in these times, such projects should have high priorities for the use of national resources and research funds.

Acknowledgements

Thanks are due to F. E. T. Suckling for provision of information for this paper; also to W. G. Payne for the preparation of the diagram.

CONTROL OF INSECT PESTS IN PASTURE

J. A. GRAHAM*

THERE can be little doubt that control of insect pests by the use of modern chemicals has been one of the most important practical advances made in New Zealand agriculture since World War 2. Nevertheless, it has been estimated that grass-grub and porina alone are still responsible for reducing the value of pasture yields by £30 to £40 million annually.

It is open to question how reliable this estimate is, but it is certain that the loss in agricultural production caused by these pests is very considerable and a major improvement in control would not only result in greater profits for farmers but would go a long way towards solving the balance of payments problem which is causing the Government so much concern at present.

Prior to the late 1940s, practically nothing could be done to control many insect pests but with the advent of the chlorinated hydrocarbon group of chemicals, especially DDT, dieldrin and lindane, it has been possible to reduce considerably the colossal damage which was occurring in pastures. These chemicals proved to be effective in giving economic control of a number of insect pests on a large scale. In addition, the residual effect on some of them was long lasting and pastures could be proofed against further attack for periods of up to three years.

For over ten years, unrestricted use of the chlorinated hydrocarbons was permitted and it was not an uncommon occurrence for DDT to be applied to areas which were still being grazed by stock or to pastures almost long enough to be cut for hay. It was not surprising, therefore, that some farmers began to complain about the ineffectiveness of the insecticides; in addition, there developed a residue hazard in farm produce.

In an attempt to overcome the residue problem, the Agricultural Chemicals (Insecticides) Regulations 1961 came into being. These did not, however, bring about the desired results, and residues in meat and dairy produce continued to be high. The most common causes were pasture contamination by airborne drift of insecticide applied to adjacent areas and the flagrant violation of the regulations by a small minority of farmers. However, more stringent regulations were introduced in 1964 and these have been so

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effective that residues have now reached almost negligible proportions. This happy situation undoubtedly reflects great credit on all concerned in the implementation of the regulations. Farmers on the whole have shown a great sense of responsibility in this matter and deserve to be congratulated for their excellent co-operation in bringing about the desired results. There was a little confusion when the new regulations were first introduced last year but this appears to have largely disappeared and the position is now fairly clear to most people.

Pasture Pests

The most serious pests of pastures in New Zealand are, of course, grass-grub (*Costelytra* spp.) and subterranean grass caterpillar (*Wiseana* spp.) or, as it is more commonly known, porina. There are several others, however, that cause serious loss in pasture production such as army caterpillar, black beetle, black cricket, stem weevil, Australian grass-grub, slugs and to a lesser extent white fringed weevil and springtails.

Subterranean Grass Caterpillar (Porina)

This insect is present in most districts to varying degrees and is undoubtedly proving to be one of the most difficult and costly of all to control. The ravages of this pest appear to be increasing, particularly in the southern part of the North Island and in most parts of the South Island. In the North Island, the hilly country is the worst affected, especially where stocking rates and soil fertility levels are low. High-producing farms can also be heavily infested. However, the impact on pastures carrying seven ewes to the acre is nowhere as great as it is on those that are supporting only two ewes or less per acre. On many farms, porina is a far greater problem than grass-grub, but often farmers are not aware of this fact because porina damage is often more insidious.

The adult of the porina is a moth which, unlike the adult grass-grub, does not cause any damage to plants. There are three main species, two of which fly and lay their eggs in the spring and one which flies after Christmas. It can be seen, therefore, that the caterpillars do not all hatch out at the same time. Indeed, in dry seasons, there is often little evidence of their presence until after the early autumn rains have fallen. The young caterpillars spend the first few weeks of their lives on the surface but later construct

tunnels in which they rest in the daytime, emerging at night to feed on the surface.

Some farmers appear to have difficulty in detecting the presence of porina in their pastures, but this is usually readily revealed in heaps of castings over the entrances to their tunnels. These contain silken-like threads and are more friable than worm casts. Bare patches in the pasture often provide further evidence of their presence.

Chemical control of porina has never been easy for even the old dust-form of DDT superphosphate, although giving a rapid kill, did not have the same residual effect with porina that it had with grass-grub. The best approach to control seemed to be to treat pastures every two years rather than at three-yearly intervals as was recommended for grass-grub.

The granular and pelleted formulations of DDT as well as the other chemicals now being recommended for porina control are proving to be less effective and more costly than DDT dust and DDT emulsion. Used in their right place, however, and at the right time, they can be a useful weapon in the control of this pest.

On hill country, the best approach to reducing the effect of porina is to build up the fertility of the pastures by heavier topdressing and stocking for there is little doubt that vigorous, high-fertility pastures withstand the ravages of porina much better than poor ones. In addition, on country where porina is a recurring problem, and especially where grass-grub is also a problem, it would be advisable to apply granulated DDT superphosphate regularly. This should be done every second year at least; in fact, it is probable that annual applications should be considered. However, if this were done, the rate of DDT could possibly be reduced to 1 lb active ingredient per acre instead of the usual 2 lb rate.

DDT is probably best applied about late February or early March as at that time of the year most of the caterpillars have hatched out and a good kill can be expected. However, DDT, unlike trichlorfon and diazinon, does have some residual effect and time of application may not be quite so vital as with the other two. No matter what form of treatment is used, pasture should be grazed short beforehand and stock should be removed for the time stipulated in the insecticide regulations.

The cost of DDT superphosphate varies considerably according to source of supply and distance from the fertilizer works. At Woodville, for instance, applied to pasture

at 2 cwt/acre, it may cost only about 36s. per acre (the DDT component costing about 10s. per acre) but only two or three miles away on the western side of the ranges the cost may be over 44s. per acre; and if the odd bag from the east should find its way to "west of the wall" then this is not to be wondered at.

Diazinon in both the pelleted and wettable powder form, and trichlorfon (dipterex) soluble powder will give good kills of porina and on vehicle country spraying with either of these chemicals for sporadic infestation is recommended. Trichlorfon wettable powder (dipterex) at 1 to 1¼ lb/acre will cost about 14s. to 18s. per acre depending on the rate of application, and diazinon wettable powder at 1½ to 2 lb/acre will cost from 22s. to 29s. for the insecticide. The withholding period for diazinon is seven days and for dipterex 14 days. These two formulations could also of course be sprayed by plane on to hill country but in most instances the cost would be prohibitive.

Diazinon prills, which have no withholding period, are recommended for hilly country that cannot be treated by ground equipment. The recommended rate of application is 15 to 20 lb/acre and at the higher rate the cost is about 38s. One of the problems of chemical control on the hills is the patchy nature of infestations. Often it is a practical impossibility to separately treat the infested patches with prills by plane and very often farmers cannot afford to treat the whole farm just to gain control in the patches. In such cases, hand application appears to be the only solution. Some farmers have applied prills very effectively with seed fiddles and the application of dusts or sprays (provided there is a handy water supply) by motorized knapsack sprayer is quite feasible. However, any treatment can be costly, and costs of control measures have to be weighed carefully against loss of pasture production.

Grass-grub

Grass-grub may be found in all parts of the country and on practically all soil types but the main damage occurs on the lighter, friable and free-draining soils. Potentially, it is still the worst insect pest but its control over the past 15 years or so by use of DDT has been one of the outstanding features of New Zealand agriculture.

A great deal of publicity has been given in the past year or two to the fact that grass-grub is becoming tolerant to DDT in some places but the total area of apparent tolerance is really not very great. Many of the cases of apparent DDT

failure have in fact been proved to be the result of poor distribution of the insecticide.

On most soils, DDT properly applied can be expected to control grass-grub for periods of up to three years and on farms prone to attack the recommended management procedure is to treat about one-third of the farm each year, including any paddocks that are being sown down in new pasture. Leaching and chemical breakdown may reduce the effectiveness of DDT on certain soil types and this may necessitate more frequent applications in certain localities. However, the local farm advisory officer can usually advise on this point.

Most of the grub damage occurs from January to June but very often the farmer does not notice that his pasture is affected until April or May. It is then too late to apply insecticidal treatments for current season's infestations because by the time it becomes effective many of the grubs will have finished their feeding and completed the damage. DDT tends to be slow acting against grub, especially when rainfall is low, and application should therefore be made at least four months in advance of the period when damage becomes visible in the pasture.

It is very important that pastures be in a short condition prior to treatment for the insecticide must reach the ground to be effective. Long pasture prevents this happening to some extent and in any case it is a contravention of the insecticide regulations to apply DDT to long pasture. Many farmers, however, seem to have hazy ideas about what constitutes short pasture and in far too many instances the insecticide is applied to pasture which is far too long. Heavy concentration of stock per acre is about the only way to obtain the desirable shortness. Fortunately, this can often be done with the ewe flock in January, which is usually quite a good month to apply the DDT anyway.

Unsatisfactory distribution of the DDT is undoubtedly one of the main causes of poor grub control. Soil samples have revealed differences in DDT content in the same paddock ranging from less than ½ lb of DDT/acre where grub control has been poor to 8 lb/acre where the control has been satisfactory. The most common causes of poor distribution are: (a) Bulk spreaders often do not spread the DDT superphosphate evenly; (b) the DDT is often poorly mixed through the superphosphate when prills are added to the superphosphate at the time of sowing; (c) operators are often too optimistic about the effective width of spread of their machines thus leaving strips untreated; and (d)

crescent-shaped areas are often missed at the corners when machines are turning.

Granulated DDT superphosphate is the best and cheapest form in which to apply the insecticide. However, in districts where it is not available, there is no alternative to prills either mixed with the fertilizer or sown on their own with special equipment. No permit is required to apply DDT in these forms provided the pasture is short. Dairy cows must be withheld from grazing treated areas for four weeks and all other stock for two weeks.

Australian Grass-grub (*Aphodius howitti*)

A fairly new pest is the Australian grass-grub. It is spreading in the South Island and is reported from Whangarei, Devonport, Ohakune and Hawke's Bay in the North Island.

The grubs hatch out in early autumn and if the soil is relatively dry at this time they feed on roots until the soil becomes moist enough to enable them to tunnel freely. When this happens, they construct more or less vertical tunnels (like porina) from which they emerge at night to feed on the surface vegetation and on dung if it is available. The majority remain in their tunnels during the daytime but those which manage to find a plentiful supply of dung remain above ground in the dung until it is eaten. The tunnels are open at the surface and usually have freshly excavated soil around the entrances. The larvae stop feeding in August or during September.

This is an important pest which appears to be spreading, and one which may not be amenable to control by DDT. (The Australian recommendation is for 4 oz of lindane mixed with superphosphate/acre, which of course can be applied only under permit.)

Black Beetle

This is a serious pest in the Auckland province and it is spreading to other districts. It causes greatest damage on coastal sand country and one hates to think what will happen when it eventually reaches the sand country on the south-west coast of the North Island.

Both the adult beetle and the grub feed on pasture. The grub is very similar to grass grub but is larger when fully developed. Dieldrin is usually the control recommended, being applied at 8 oz of active ingredient/acre in prill or pellet form. A prior permit must be obtained to use dieldrin and the withholding period is eight weeks for prills or pellets.

Crickets

Cricket damage can be extreme because they can kill practically all pasture plants. They frequently cause fairly severe loss in pasture production in parts of the Manawatu, especially in the Opiki district and in parts of the Kairanga. They can, however, be readily and cheaply controlled by use of dieldrin and malathion baits.

Army Caterpillar

This caterpillar regularly attacks barley and maize crops and also it sporadically causes severe damage to thousands of acres of pasture. There are usually about three generations in a season and mainly it is the last two that cause greatest harm. Pasture infestations tend to be confined to those pastures that tend to be rank and this can be advanced as another reason for heavier stocking. Fortunately, the caterpillars can be easily controlled with dipterex at the rate of 1 lb/acre. A stock withholding period of 14 days must be observed.

Slugs

Slugs cause a great deal more damage to farm crops and pastures than is generally supposed. Not infrequently they have a drastic effect on oversown clovers on hill country and establishing species on chemically renovated pastures. They are also very frequently the cause of poor establishments in autumn-sown pastures, especially when the seedbed is cloddy or when trash has been left on the surface. Poor strikes of brassicas can also often be attributed to these pests. They can be readily controlled by metaldehyde baits; 2 lb of metaldehyde powder is mixed with about 100 lb of bran and the mixture is applied at about 10 lb/acre.

White Fringed Weevil

The white fringed weevil is becoming a serious pest of crops in Hawke's Bay and Manawatu sand country.

Conclusion

The control of insects in pastures has raised agricultural production by many millions of pounds annually but there is still tremendous scope for improvement. Far more knowledge of this neglected subject is required and far more scientists should be working on these problems.

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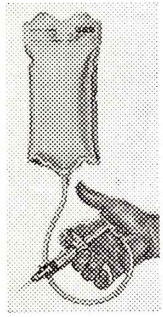

TVL and animal health

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830

A. P. Underhill

Well established lucerne on pumice soil near Murapara.

LEGUME INOCULATION: WHAT IT IS AND WHAT IT DOES

A. HASTINGS*

PLANTS must have nitrogen for growth. For the world's annual food production, 110 million tons of nitrogen are required. Only 7 million tons of this is supplied by the chemical industry (Dahr, 1959) and much of the rest comes from legumes. Legumes are plants such as peas, beans, lucerne, clover, lotus and even gorse, that have special bacteria on their roots and make use of nitrogen from the air. The air we breathe is primarily a mixture of nitrogen and oxygen gases. About 80% by volume is pure nitrogen in a free state and there are approximately 35,000 tons of this free nitrogen above every acre of land; in this form it is totally useless to plant or animal life.

Farmers are very fortunate to be provided by nature with a simple and cheap method of obtaining some of this nitrogen from the atmosphere by the growing of legumes.

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In contrast to most plants, legumes are able to use or "fix" atmospheric nitrogen, not only for their own growth but also to provide a surplus for other plants and at the same time to improve soil fertility. This nitrogen would otherwise have to be applied as a fertilizer. Dr J. Melville (1953), a well-known grasslands scientist, drew attention to this when he said, "Nitrogen deficiency in our pastoral land is the main nutritional bottleneck to increased production. The key to the situation lies in the clover plant which has the capactiy not only to supply its own requirements of nitrogen, but to produce a sufficient surplus to keep the associated grass in a state of good nitrogen nutrition".

In trials at Palmerston North (Melville and Sears, 1953), a sward consisting of sown grasss with clovers (mainly white clover) under a regime of mowing and removing, when compared with grass alone, yielded an extra 1,430 lb of nitrogen during three years. This is equivalent to an average annual fixation rate of 539 lb of nitrogen per acre and is an outstanding example of the ability of nodule bacteria to fix nitrogen from the air.

Soon after a legume begins to grow, special bacteria called nodule bacteria or rhizobia invade the tiny root hairs and multiply in large numbers, forming growths called nodules. This establishes a definite partnership, a living together of two to the advantage of both. The plant furnishes the necessary food for energy which enables the bacteria to fix free nitrogen from the atmosphere. The bacteria then make the nitrogen directly available to the plant. This process is known as symbiotic nitrogen fixation. The quantity of nitrogen taken from the air and fixed depends on several factors, namely:

(1) The kind of legume.

(2) The effectiveness of the nodule bacteria.

(3) The soil conditions.

(4) The presence of necessary plant food other than nitrogen — *e.g.*, phosphate, potash, lime, trace elements such as molybdenum, copper, and boron.

In high-fertility soils well supplied with available nitrogen, there may be little or no fixation as the plants use the available nitrogen in the soil and do not encourage the bacteria to fix more. Consequently the most spectacular results from legume inoculation are obtained on lower-fertility soils or on run-down depleted soils.

The Need for Inoculation

In New Zealand, nodule bacteria for all the pasture and crop legumes must have come originally from overseas, as there are no native plants which could serve as hosts for the bacteria. With the development and settlement of the country, nodule bacteria have been widely distributed by dust, flood water, the feet of animals, cultivating implements, in lime and on sown seed. With the bacteria distributed by these chance means, clover and other legumes have been successfully established in the past over much of the country. In many low-fertility areas now being developed, nodule bacteria, if present at all, are in small numbers, and it has been shown that it is necessary to supply the bacteria with the seed if good nodulation and healthy clover are to result. This is done by seed inoculation. The method of inoculation is to add a culture of effective selected strains of legume bacteria to the seed. This puts the bacteria in the right place to enter the root hairs of young seedlings and begin their beneficial work.

Farmers cannot be sure before they plant a legume that sufficient bacteria of the proper kind are present in their soils. Neither can they be sure that the bacteria, if present in the soil, will be highly efficient types and give maximum benefit to the crop. If the proper effective bacteria are not present, the young plants become sickly yellow and spindly and may or may not have nodules on the roots and therefore cannot fix nitrogen. There is more difficulty in getting grown plants inoculated than inoculating the seed before planting. Many present sowing failures and slow rates of establishment can be attributed to inadequate nodulation. Therefore, with land development now largely confined to more difficult soils and situations, and with good quality inoculants readily available at nominal cost (3½d. for each lb of seed treated), it is no longer wise to take a chance on inoculation failure. As a general rule, whenever a legume is being sown in a new area, the seed should be inoculated unless there is evidence to show that inoculation gives no benefit. Lucerne should always be inoculated.

Inoculants

The bacteria-impregnated material used to inoculate seed is called the inoculant or "culture". This may consist of a thick growth of live bacteria on a jelly-like medium or, more commonly now, a suspension of living bacteria in a

finely ground peat carrier. Specific directions for using these high quality commercial inoculants are on the label of each culture container. It is essential to follow the directions closely, and to be sure that the correct culture is used for the seed being inoculated and that the culture is used before the expiration date stamped on the packet.

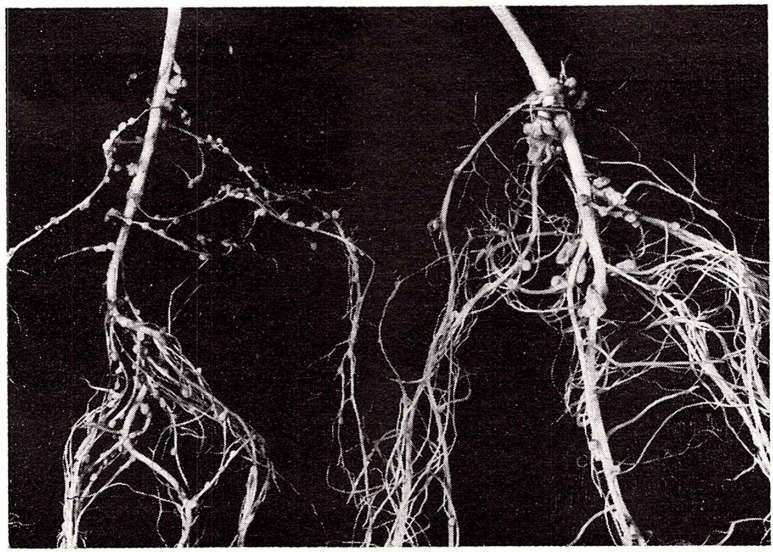
Certification of Legume Inoculants

To protect farmers from buying worthless cultures, a scheme for the certification of legume inoculants was commenced in 1955 at the Plant Diseases Division, Auckland. This scheme ensures that cultures offered for sale contain adequate numbers of nodule bacteria of proven efficiency, and as a result of this scheme the quality of inoculants available in New Zealand has greatly improved in the last few years. New Zealand commercial cultures for the inoculation of legumes have reached a high standard of reliability and usually produce satisfactory results.

Conditions affecting Legume Bacteria

It must be stressed that cultures of legume bacteria are alive and should be treated as living things. In natural competition between other microbes of the soil, the legume bacteria have the advantage that they are protected from time to time in nodules. Without this association they would have to cope with adverse soil conditions. Conditions essential to the satisfactory growth of legumes must, of course, be fulfilled before maximum results with inoculation can be expected. However, once the bacteria are in the soil they are subject to the conditions existing there, so that, if the chemical reaction of the soil is suitable, if sufficient moisture and plant food is available, and if temperatures are not too high, the bacteria should function normally.

Acid soils tend to eliminate the bacteria because the organisms are not tolerant of acid conditions. Nodule bacteria from lucerne and red clover are among those that are the least acid tolerant, whereas bacteria from lupins, gorse or lotus are considerably more acid tolerant. Nodule bacteria will tolerate low temperatures much better than high temperatures. Exposure to heat that is unbearable by man or even uncomfortable may damage or destroy their effectiveness. Inoculated seed should not come in direct contact with acid fertilizers. Normally inoculated seed should not be sown with superphosphate, aerial superphosphate,



J. W. Endt

FIG. 1: *Subterranean clover roots showing nodules. Left; ineffective: Right; effective nodules.*

nitrate of soda, sulphate of ammonia, potash, or any manure containing soluble nitrogen or potash. However, the seed can be sown with reverted superphosphate, superphosphate plus lime, serpentine superphosphate and lime, and rock phosphate.

Pelleted Inoculated Seed

In order to overcome some problems that occur with the use of ordinary inoculated clover or lucerne seed, a new method was developed and introduced in 1962 known as pelleted inoculated seed. In this method more nodule bacteria are added to the seed and they are covered with a protective coating which also has some nutritional value. Because of this the rhizobia remain alive longer on pelleted inoculated seed. This means that seed mixtures can be made up in advance of the sowing date and still get the benefit of inoculation. The seed can be surface sown and still have a good chance of being effectively nodulated when the seed germinates. It can be sown in contact with superphosphate and other fertilizers without damaging the nodule bacteria. In soils where acidity is marginal for effective nodulation, pelleting could make the difference between success and

failure. In short, pelleted inoculated seed allows legume establishment on soils and under conditions where conventional inoculation fails.

Strain Variation among Legume Bacteria

It must be emphasized that all legume bacteria are not the same. Some are effective only on single species, whereas others effectively inoculate groups of legumes. There is also a difference in effectiveness between strains isolated from the same legumes and from different legumes in the same group. For example, nodule bacteria isolated from vigorous white clover can be ineffective on subterranean clover or red clover, and the reverse also applies. As nitrogen fixers some are highly effective, some are poor, and others show graduations between these extremes. Large numbers of effective bacteria added to the seed could prevent the entry of ineffective strains already in the soil. This type of strain variation has great practical significance. It is important that only strains of highly effective nitrogen fixers are used by manufacturers of commercial inoculants.

The search for new and better strains is a continuing one, for the inoculants that give greatest benefit under field conditions are the ones required by the farmer. For this reason considerable research work has been put into the selection of highly effective nitrogen-fixing bacteria. These are supplied to the manufacturers of commercial inoculants in New Zealand. Glasshouse tests enable a selection of the best strains of a given legume, and field tests further evaluate better strains in the field. At this stage some important observations should be stressed:

(1) Lucerne strains will inoculate lucerne but not clover.

(2) Clover strains will inoculate clovers but not lucerne.

(3) Selected effective strains will inoculate a group of the same species — *i.e.*, a good clover strain will work effectively on red, white, subterranean and alsyke clover: a good lucerne strain will effectively inoculate different varieties of lucerne.

Results from Inoculation

As mentioned earlier, lucerne should always be inoculated and in New Zealand this has become standard farm practice. This practice has enabled much more lucerne to be established successfully, and has enabled the growing of

lucerne in areas previously considered unsatisfactory. Just over 169,000 acres were sown in the season 1962–3. Inoculation of clover seed is not standard farm practice, because establishment of clover is not difficult on the higher-fertility soil types. However, big responses to inoculation of clover seed have been obtained in field plots and large-scale sowings on the Northland gumland soil types, on pumice soils of the central North Island plateau, the pakihi problem soils of Golden Bay and the West Coast. Good results have also been obtained in land development blocks on the West Coast and in Southland and Otago. Many farmers developing hill country are now also sowing pelleted inoculated seed.

The demand for effective legume inoculants in New Zealand has shown a rapid and steady increase since World War 2. Probably no commodity purchased by farmers is capable of giving a better return for every shilling invested. The cost of inoculants is 8s. 9d. for 30 lb of seed. In the case of clover, this quantity will inoculate 6 to 10 acres depending on the seeding rate, so seed inoculation is very cheap crop insurance.

For successful inoculation the following points are most important:

(1) Use the right inoculant for the legume.

(2) Keep the culture in a cool, dark place until used.

(3) Follow directions and mix cultures well with the seed.

(4) Plant seed as soon as possible after inoculation.

(5) Inoculate if in doubt and always inoculate legumes sown on new land.

(6) Prepare a good, well-fertilized seed bed.

(7) Use pelleted inoculated seed if sowing by air or surface sowing without covering or sowing seed with superphosphate or other acid fertilizers.

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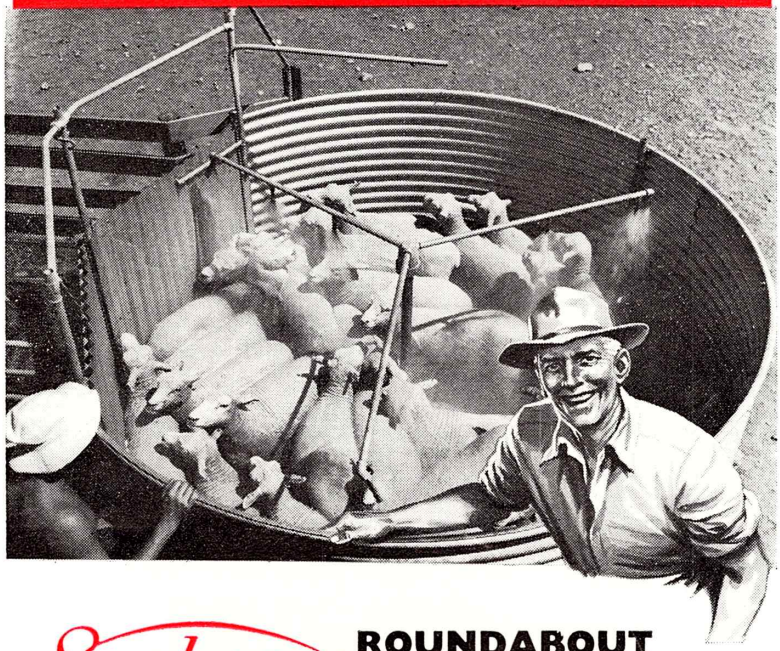

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MASSEY YORKSHIRE FOG

G. S. ROBINSON*

THE NUMBER of varieties of grasses sown in pastures in New Zealand is very limited; seed merchants' price lists indicate fewer than half-a-dozen popular species. Yet an examination of pastures reveals a large number of grasses present. Many of these can be easily recognized as being of little use — *e.g.*, hair grass, sweet vernal and *Poa annua* — but others appear to have a much greater potential — plants like tall fescue, Kikuyu grass, prairie grass and the subject of this paper, Yorkshire fog. Grasses such as these seem to have advantages in either total or seasonal production that make them worth investigating. Up to now experimental work has largely been concentrated on the ryegrasses, cocksfoot and timothy in New Zealand. Future studies will almost certainly widen the range of economic varieties.

Yorkshire fog is a grass that is well known in all districts of New Zealand, having been introduced in the early days of settlement — probably as an impurity in other lines of grass seed from Europe. It is a grass of temperate climates and appears to have originated in the Spain-Portugal area. However, it has become widely spread in all the temperate regions of the world, and in Chile, for example, it is one of the main constituents of pastures.

In New Zealand, farmers have come to associate Yorkshire fog with its tolerance of a wide range of temperature and soil types, and of grazing.

Temperatures: It grows well in the most northerly parts of North Auckland and yet is a valuable contributor to the grazing of many areas of tussock grassland in the South Island. Mitchell (1959) found in controlled environment studies that growth of leafage remained high at all temperatures between 55°F and 85°F with the optimum in the region of 62°F and this bears out the general experience with the grass.

Soil Types: Yorkshire fog will grow on many soil types ranging from sands and pumice soils to peats and heavy loams. Although its optimum growth takes place in soils that are not excessively acid, it is well recognized as a grass that will persist and yield well on peats. It is, in fact, recommended on such soils when adequate liming is not possible. Soil moisture supply is more critical in restricting growth

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of fog and it tends to become aggressive only where this is good, as in high rainfall areas and where ground-water is close to the surface (Jacques, 1962).

Grazing management has long been considered the reason for Yorkshire fog increasing in pastures where it is present. It can be considered intermediate between perennial ryegrass and cocksfoot in its tolerance of grazing and tends to be encouraged by a moderately-lenient system of defoliation. Goodall in 1943 found that Yorkshire fog performed better under lenient rather than under intense grazing. Its yield was somewhat less over the whole year than perennial ryegrass, but in the winter months production was 25% more than that of perennial ryegrass. Edmond in 1964 has found that, under both moderate and heavy treading with the soil at field capacity, commercial Yorkshire fog was very severely damaged and this could possibly be the main factor in regulating ingress of fog into many pastures. However, he considered that, where three to five sheep equivalents per acre are carried — *i.e.*, about the usual stocking rate for good pasture — Yorkshire fog is moderately tolerant of treading.

Disadvantages: Lack of palatability has been considered by farmers to be one of the main disadvantages of Yorkshire fog. This has generally appeared to be more serious where stocking rates have been too low in the spring during the main flush period to keep pastures in control, with the result that much mature growth has appeared. Where this has been prevented, the problem of evenly grazing pastures containing much fog disappears. In the young, leafy stage of growth it is readily eaten, but there is no doubt that there is a decline in palatability with maturity. This is possibly associated with its hairiness. Prevalence of rust has also been associated more with Yorkshire fog than with other grasses and this probably has had an effect on animal preferences. As with other grasses, strains can be isolated that are relatively resistant to rust, and this need not therefore always be a problem.

Experiments have from time to time been carried out with commercial varieties of this grass to compare them with other species, particularly as far as yield is concerned. Monro and Schwass (1960) at Massey measured yields of fog from plots under mowing in comparison with ryegrass, cocksfoot, timothy and prairie grass, growth being allowed to reach about 3 in. in height. Overall, the yields of dry matter were very similar to those of both perennial and

short-rotation ryegrass. Cocksfoot was much better under this management and timothy and prairie grass both much poorer.

At Lincoln, Watkin (1961) carried out a comprehensive grazing trial over a period of three years with nine different grass species. Grazing took place whenever the herbage reached a height of 5 to 6 in. and reduced the swards to approximately one inch. Under the Canterbury conditions, Yorkshire fog yielded as well as any of the other grasses. Distribution of growth through the year was very similar to the ryegrasses, as also was the proportion of white clover growing with it. Perennial ryegrass was rather better in maintaining a greater freedom from weeds and weed grasses.

In 1953, Jacques and Schwass made a collection of commercial Yorkshire fog seed samples representing local populations from most areas of the North and South Islands, and certainly very similar to the material used in the above trials. Continuous examination of single plants from this collection was carried out over a period of about eight years by Jacques and resulted in a group of selected plants of high agronomic value. Progeny testing indicated that they were also satisfactory for breeding purposes.

The major objectives in this improvement programme were those associated with utilization and palatability of the grass. Five features seemed to need improvement:

(1) Habit of growth. Preliminary studies suggested that plants adopting a semi-erect growth form with good growth on the crown would be the best.

(2) Hairiness. Completely hairless varieties are unknown but the Plant Breeding Station in Wales did manage to breed a type with very few hairs. Samples from different districts in New Zealand showed great variation in this characteristic and selection of a less hairy type was made.

(3) The proportion of dead basal material. No marked difference was noted between lines in this characteristic.

(4) Resistance to crown rust. Marked improvement was brought about by selection.

(5) Compatability with legumes in the sward. This is important where legumes are relied on for nitrogen supply — *e.g.*, North Island hill country. It was not

possible to specifically select for this and it appears that, in producing a strain of greater vigour, clover is more restricted.

The first trial plots put down to test the selection were small ones and yields were recorded by mowing. They were maintained over a two-year period and showed that the bred material had better persistence than the commercial type, and showed less inclination to be attacked by rust. In addition, the yield in relation to the ryegrasses and cocksfoot gave confidence of its being able to produce worthwhile quantities of stock feed.

Although mowing is a convenient means of recording growth of grasses, it tells nothing about how they behave once stock get on them. A more comprehensive experiment was therefore designed. By this time sufficient seed was available to sow out small self-contained paddocks which could be grazed separately. Comparisons were made with Ariki ryegrass, Ruanui perennial ryegrass, and Manawa (short-rotation) ryegrass. All grasses were sown with white and red clovers. Samples were taken from the grazed plots over a period of 2½ years. At first a rotational grazing technique was used, the plots being grazed whenever they reached a height of 4 to 5 in. This was generally satisfactory with the ryegrasses but it was found that the sheep coming off other pasture on to pure Yorkshire fog found it unpalatable, with the result that it was difficult to graze it off evenly. In the final year a flock was assigned to each species and was moved round the three replicates. The size of this flock was adjusted from time to time so that the pasture was kept in control — *i.e.*, about 1 to 3 in. in height. This method of grazing overcame the palatability problem completely and the stock on each species seemed to thrive equally well.

From this grazing trial, which was on medium fertility soil under moderate levels of topdressing, the following conclusions could be drawn:

(1) The bred Yorkshire fog yielded at least as well as the ryegrasses and carried similar numbers of stock.

(2) Its spring production was not particularly outstanding and was characterized by a relatively low proportion of clover.

(3) Summer yields were very good throughout the trial and may have been helped by the even grazing of the short pasture. Little build-up of dead material was noticed.

(4) Autumn growth was also good and recovery after a dry period was much better than is normally associated with Yorkshire fog.

(5) However, it was in the winter that the selected Yorkshire fog was most promising. In both years it produced more than any of the ryegrasses at this period. At the stocking intensity used, and this was quite high, no serious damage from treading occurred and a tight cover was easily maintained.

It should be emphasized that these are the results of only one grazing trial and that much more experience is required with the selection before it can be generally recommended for any particular situation. However, it looks sufficiently good to warrant further trials. More must be known of its performance generally on a variety of soil types and as much information as possible is needed on how stock produce on it. Trials are being planned for this purpose.

It would seem that the most likely place for an improved Yorkshire fog would be on soils of moderate fertility. The possibility of introducing it to some of the higher rainfall hill country immediately suggests itself. Renovation of such pastures with chemicals is the logical way to make this introduction, and further work is necessary in this direction. It is necessary to know more about the methods of introduction and also how this new type of Yorkshire fog will thrive and produce in competition with other species on hill country.

From this, it will be gathered that Massey Yorkshire fog still has a long way to go before it can be generally recommended. The results of the relatively small amount of work that has been done in its selection and testing are promising. Further improvements are certainly possible.

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ALTERNATIVES TO WOOL BRANDING FOR SHEEP IDENTIFICATION

G. L. WICKENDEN*

THERE HAS BEEN a big improvement in the treatment of wool over the last twenty years. Up to 1945, substances such as paint, tar, or pitch were recommended for wool branding. At that time branding was compulsory, except in certain exempt districts. A branding race was sited handy to counting-out pens and sheep were branded as a matter of course and without any realization of the damage which was being done to New Zealand's reputation as a wool producer.

"Tar!" was a familiar cry on the shearing boards — it still is in some sheds; but it is hoped that all cuts are today treated by a scourable disinfectant and not by this black bogey of all wool manufacturers.

A real step forward came with an amendment to the Stock Act in 1945 which provided that only Government tested and approved scourable wool-marking preparations could be sold or used; the dilution of approved branding fluids with harmful ingredients such as engine oil was also prohibited. Over the years it has been the job of the Sheep and Wool Section of the Department of Agriculture to carry out all the trials on wool-marking materials submitted to the Department for scourability. This work has been described by J. E. Duncan (*N.Z. J. Agric.*, Oct., 1952).

In 1956, an amendment to the Stock Act made wool branding *optional* instead of *compulsory;* and this was the beginning of the end of branding. A later amendment to the Stock Act specifies that from October 1, 1965, only approved raddles, approved tupping crayons, and approved marking pencils may be used for wool marking sheep.

The intention in this paper is to discuss briefly some of the alternative methods of sheep identification which might be of interest to farmers.

Brand

As from October 1, 1965, an applicant for a registered "brand" will have the choice of an earmark or firemark; or he may register both if he wishes.

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* Department of Agriculture, Wellington.

Earmarking

A registered earmark is the most practical and commonly used permanent identification. Placed in opposite ears of ewes and wethers it indicates their sex.

Firemarking

Although the Act says that "a firemark distinctly and plainly made on the horn or face" may be registered as a brand for sheep, it is seldom used in New Zealand, except perhaps on the horns of Merino and Dorset Horn sheep.

The difficulty of developing suitable equipment for getting the brand burnt evenly on to the faces of sheep and the time taken to brand each sheep, which in one trial was reported to be over half a minute, mitigate against this method of branding.

Agemarking

To legalize agemarking and the use of eartags for sheep and cattle, the Stock Amendment Act 1956 makes provision for the use of a specified agemark and a tag hole; and provided these are made with pliers which make an agemark and tag hole of the approved dimensions, any farmer can agemark and use eartags.

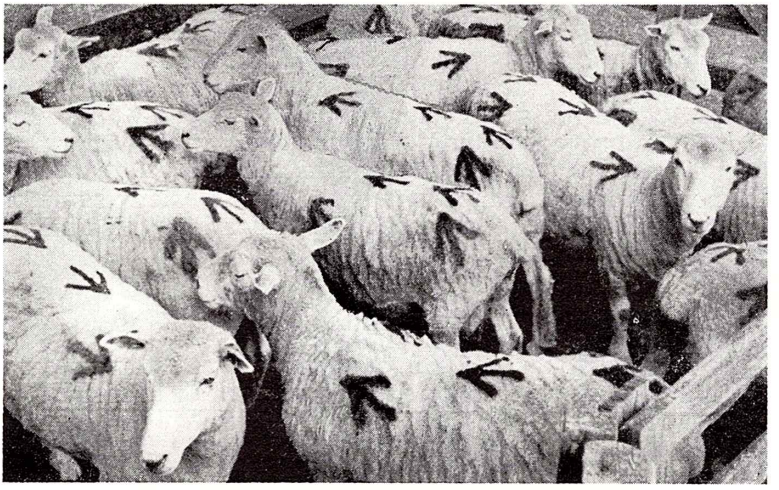

Fig. 1: *Branded sheep under official trial.*

FIG. 2: *A brass eartag.*

On properties breeding their own replacements, a registered earmark and an agemark are generally used.

Bought-in sheep with a variety of earmarks may be identified by a tattoo or eartag.

Tattooing

Any farmer may use a tattoo provided the system he uses does not resemble the marking system of any registered standard stock mark. Tattooing is a permanent means of identification. However, it is a slow job and has to be done properly to be effective. Sheep have to be caught to read the tattoo.

Eartags

Metal and plastic eartags are used for individual identification of sheep and in addition the plastic tags are used in a variety of colours for agemarking.

METAL EARTAGS — THE BRASS TAG

A good example of this type of tag is the plain oblong brass tag. A hole is punched in the ear, the tag inserted, and special pliers are then used to close these tags. Letters and/or numbers stamped on these tags are always legible. As

the tags are smooth they do not cause irritation, and they last well if care is taken to put them in correctly. They weigh 4.2 grams and are inclined to make the ears of young lambs droop because of their weight. This tag is sometimes fitted in the centre of the sheep's ear, the tag being threaded through two punch holes placed between the veins. In this position the tag is easy to read and not readily fouled by a shearing handpiece. It could, because of its fixed and restricted position, be the cause of some irritation and damage, especially in sheep with thick ears.

The Self-piercing Tag

This tag is placed in position in the special pliers and when the pliers are closed the sharp point of the tag pierces the ear and goes through a hole in the opposite side of the tag. It is turned over and locked in position by the pliers all in the one operation.

These tags are probably the most quickly fitted of all eartags and are useful when lambs are tagged soon after birth for individual identification. A light tag is especially useful for this purpose. Once locked in position, these tags are difficult to remove and usually the ear has to be slit or the tag cut to detach it. This makes this metal tag a fairly permanent fixture, provided it is not snagged and pulled out.

The self-piercing tag is inclined to cause irritation in the sheep's ear and to gum up with wax and dirt. For this reason these tags should be inspected from time to time and foreign matter removed.

Disadvantages of Metal Eartags

Metal tags can be a special hazard to a shearer. If a shearer is unlucky enough to strike an eartag when shearing, the result may be a broken comb and cutter and sometimes further damage to his handpiece and other shearing gear. The handpiece may also be jerked out of his hand and before the power can be cut off may cause damage to himself or to someone else or to the sheep. It is a wise precaution for sheep owners to warn shearers when their sheep carry eartags.

The safest position for an eartag in respect to visibility to a shearer is in the front of the left ear.

Some metal tags, although bright and shiny when purchased, become so rusty after use and weathering that any numbers, letters or symbols on the tags are very difficult to decipher.

Plastic Tags

Plastic tags are now available in a variety of colours. These different coloured tags are easily distinguishable in sheep's ears and the sheep can be drafted into various groups without handling individual animals.

Plastic tags are used mainly for agemarking (a different coloured tag being used for each age group) and for sex identification, when tags are put in opposite ears for ewes and wethers. They can be used also for identifying cull sheep and a particular coloured tag can be reserved for this purpose.

If it is necessary to identify individual sheep, plastic tags stamped with the required names, numbers, letters or symbols can be purchased.

Some Disadvantages of Plastic Tags

Some plastic tags can be taken out of the sheep's ears without much damage to the ears and different tags can be substituted. While this practice is convenient when working with experimental groups of sheep, it could be abused if practised by unscrupulous persons.

Some open-ended plastic tags (now no longer available) when attached to the front of the sheep's ears swivel and the open ends nip on to the ears, causing irritation and in some cases cut right through the ear. The lapover tags give less trouble in this respect.

The weight of some plastic and metal tags cause the ears of young lambs to droop. This disadvantage can be overcome by delaying the tagging until the lambs are approximately six months old. When lambs are eartagged at birth for individual identification, this delay is not practical.

A certain proportion of all types of tags are lost through various causes, such as faulty technique in putting on the tags, infection of the ears, tags rubbed off or pulled out, or bitten out by dogs. They are not in many cases fully effective for permanent identification. The colour fades on some of the plastic tags and some become brittle and break up.

When young lambs are eartagged, the tag should not be attached so that the outer edge is flush with the ear. A gap should be left between the outer edge of the ear and the tag to allow for the natural growth of the ear. Otherwise, as the ear grows, the tag will be forced outwards causing inflammation. This, combined with the gumming up of the tag with dried blood and other matter and the pressure on the ear, may result in the tag being rubbed or pulled out.

Healthy ears and free swinging tags will help to make the tags a more permanent fixture.

Care should be taken when punching the hole for the tag to be sure that the main veins in the ear are not cut. If these veins are cut with the punch or self-piercing tag, it causes unnecessary bleeding, resulting in inflammation and damage to the ear, and an insecure eartag may result.

It is advisable to punch the hole from the underside of the ear. In this position the main veins can be seen and avoided and the punch-hole made between them. The punch itself should be sharp and clean, capable of taking out the complete section punched, not leaving a portion attached to the ear.

The sheep should be held firmly when punching its ear, as it usually struggles and damage can be caused to the ear before the punch can be removed. The eartag used for individual identification of sheep should be attached to the ear in a position where the information on the tag can be easily seen.

Trials of Other Methods of Sheep Marking

In recent years, a number of other methods of sheep marking have been suggested and have been investigated by the Department of Agriculture, the writer having carried out much of the field work concerned.

Face Branding

A special American dye recommended for face branding of sheep has been tried out. This dye was put on as a brand on the noses of sheep. It disappeared in a very short time and so was unsatisfactory.

Ear Dying

A variety of non-poisonous and durable dyes were selected and applied to the ears of sheep. Each sheep was kept in a pen by itself until the dye had dried to prevent smudging. The dyes took approximately two minutes to dry. On examination seven weeks after application, very little trace of any of the dyes remained on the sheeps' ears.

These trials showed that none of the dyes used would last long enough to be of much practical use.

Velcro Nylon Hook Tape and Sticking Plaster for Temporary Marking of Sheep

Red and white tapes and sticking plaster were applied on March 6, 1964, in different positions on lambs shorn in mid-January, 1964, and on unshorn lambs. After three months, only four tapes remained out of the 18 put on the shorn group. After five months only three tapes were missing from the woolly mob. The tapes and sticking plaster would not stick on the ears or noses of the lambs and were very insecure on topknots. The main positions used were shoulders, mid-backs, and rumps.

The tapes were very hard to see on the woolly mob but the red tapes were more easily seen than the white ones. The sticking plaster was very difficult to find at all.

The difficulty of seeing the tapes and sticking plaster, the length of wool required for satisfactory application, and the necessity of always shearing off the tapes and sticking plaster (if left on the shorn fleece these could damage the machinery in the woollen mills) and the cost of Velcro tapes could all limit their use.

Legbands

A variety of different coloured plastic legbands was sent to the Department of Agriculture. These were tried on sheep, but were, as expected, found to be impractical.

Plastic Collars

It has been suggested that light, plastic tubes or bands held together with a metal clip could be used round the necks of twin lambs as a temporary identification to replace dot branding.

These bands or collars could possibly be produced in a variety of colours, and the clips stamped with numbers, or other marks, for individual identification.

It has been reported that plastic streamers in the ears and plastic collars have been used in Michigan for identifying white-tailed deer.

In Australia plastic collars have been used for identifying red kangaroos in studies of the mobility of this species.

Conclusion

Most farmers are already well ahead of the requirement of the new Act and are now managing entirely without branding.

The search for alternatives to branding as a method of animal identification is the responsibility of every section of the sheep industry, including individual farmers. It is hoped that these remarks have stimulated thinking in this direction.

The following lists the tupping crayons, raddles and marking pencils which have been approved as at January, 1965:

Tupping Crayons:

"Sire-Sine" — Red, green, blue and yellow in hot, mild and cold grades.
"Cleanso" — Red, green, blue and yellow.

Raddles:

"Cleanso" — Red, green, blue, yellow, black, violet and orange.
"Ford's" — Red, green, blue, yellow, black, violet and orange.

Marking Pencils:

"Sire-Sine" — Red, green, blue and yellow.

SHEEP BRANDING

W. G. BOWEN*

THE identification of sheep is as old as the animal itself. In the early chapters of the Bible, where the herdsmen of Abraham and Lot were quarrelling, the dispute was probably on the ownership of sheep.

Generally sheep have been identified by a mark in the ear or a mark on the wool. For example, in the high grazing country of Great Britain the sheep are brought out after shearing to be keelmarked on the shoulder, hind-quarter or rump with a great splash of marking fluid that not only identifies ownership but also the hirsel to which the animal belongs.

As New Zealand flocks increased and the export trade of sheep meats was developed, marking of sheep in New Zealand became imperative and popular. For many years, there has been a big annual movement in sheep between the breeding and fattening areas. A farmer attending a sale, buying several pens of sheep (from ewe lambs to five- and six-year-olds), could finish up with several ear marks on his farm. With his neighbour in the same position, branding inevitably followed.

Only too frequently, one sees newly shorn sheep jammed up in a branding race, and a farmer rush into them with branding fluid. If the tin runs low with still a good number to do, it is replenished with the first thing to hand, such as kerosene, waste oil, or tar. After they have rubbed and jumped on each other, he lets them out into the front yard, looking very colourful — like a canvas of modern art. Such branding practices went unnoticed until the wool trade started making strong complaints about brands in New Zealand wool not "scouring out".

While many branding fluids passed the scour test, for reasons already mentioned there was no guarantee of all brands scouring clean. Only one or two lines of wool containing unscourable brands need enter a prominent mill with this serious blemish to result in unfavourable publicity and cast doubt on the whole national clip.

Because of these complaints, the Wool Board faced the position squarely and made a decision to get legislation passed to abolish brands.

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* Field Director, New Zealand Wool Board, Wellington.

Each is entitled to his own opinion on the merits of this action, but the writer sincerely believes it to have been a right move and that the Board should be commended for this courageous step in the interests of the national wool clip. The problem is not whether Joe's sheep get into Jim's place, whether it is more difficult to mark sheep, whether they can be more open to stealing, whether it upsets farming practices or management. The important point is the image, quality and presentation of this country's annual wool clip valued at over £100 million a year. Anything that can be done to foster, promote, or improve this most valuable commodity must be done and the Board would be failing in its duty if it did not take up the challenge.

So the Stock Amendment Act 1963 as from October 1, 1965, abolishes all brands and marking fluid.

What are the alternatives? First, as "necessity is the mother of invention", many answers to this problem can be expected in the next few years. But of present alternatives a big part of the answer to this question may well be plastic eartags.

There has been so much commercial promotion and sales of all types of tags over recent years that one hardly knows where to start in sorting out the question so that it can be viewed constructively. In general, tags have been over-promoted and oversold to farmers, without first standing up to the necessary field trials and practical tests. Salesmen have arrived at a farmer's gate complete with a colour range, suggested name, an elaborate punch, etc., and signed the farmer up with a five-year supply. When the tags have proved unsatisfactory, he cannot return them as they have his particular mark stamped on each one. It is not surprising, then, for many farmers who have had this unfortunate experience to be anti-tag and comment strongly that "tags are not the answer".

There are many makes, designs, and shapes of tags at present on the market. So that their respective merits can be assessed, the following points should be considered:

(1) A tag should not remain stationary, as the ear will fester. Because part of the ear remains covered, sweating occurs, which results in the tag rotting out, leaving a large hole in the ear. With a stationary tag, there is a tendency for grass seed and dirt to lodge underneath the tag, causing infection. Thus a tag should be able to swing in the ear, allowing no irritation, no build up

of dirt or seed, and permitting air to circulate around the ear.

(2) A tag must be smooth and have no sharp edges which would cause irritation.

(3) A tag should not have a shape or design that will allow it to catch in barbed wire, scrub, choumoellier, etc. Before a farmer buys any tag he should test this point and ensure that any type of snag will slip through the tag.

(4) A tag must be made of a plastic or any other material that will not grow brittle with age, lose its colour and generally deteriorate. The successful tag must be strong and lasting, colourfast, non-toxic, and able to withstand the chemical action of dips and dusting powders.

(5) Any tag that is designed in a way which allows it to get caught with a shearer's handpiece has little merit. Not only will the tag be smashed by the comb and cutter, but even more serious it can break the gear and be extremely dangerous to the shearer. A tag must be so designed and placed in the ear that the shearer's handpiece can follow out the ear from the base without damage. For this reason, metal tags as used on stud sheep should not be used for flock purposes unless the farmer is willing to pay "stud shearing rates".

(6) A tag must have a good range of colours, be large enough to carry a name, and to be seen clearly as sheep come through the drafting race.

The most important point to watch in attaching the tag to the ear is to fit it from the inside of the ear so that strands of wool are not forced through the ear as this can cause festering.

The minimum amount of flesh should be removed from the ear when the tag is fitted. Large punch holes tend to become larger thus making it easier for the tag to drop out. In the case of one type of tag which enjoys considerable success, the tag itself pierces the ear of young sheep so that no flesh is removed at all. In older sheep a probe or needle is used to make a small slit to insert the tag but this does not mean any loss of flesh.

It is important in any tag that the ear when healed after tagging fits snugly around the collar or base of the tag.

Colour range can be fitted intelligently for age marking, culling, etc. Liaison with neighbours in use of colours can also help quick identification. (While neighbours may use a full range of colours for age mark, they would use different colours for lambs and two-tooths, etc.)

In conclusion, can 100% lasting identification be expected? This is probably unlikely as earmarks can be mutilated and brands can fade out, but a foolproof tag developed on the lines already mentioned should come very close. (Already trials have shown losses of only 1% on some tags.)

The statement is often made that it is a simple operation to take one man's tag out and put another in. A "thief is a thief". It is also easy to change the earmark, alter or remove the brand of a stolen sheep.

For identification of sheep in fat pens at sales, etc., surely a plastic marker could be designed that would slip over the sheep's head and hang around its neck. This is used for dog trials in Britain where two of the five trial sheep are so marked, and in one stage of the trials these sheep have to be separated by the dog. Such a marker would not come off between sale and abattoirs and the same marker could be re-used. Chalk-type raddle that will scour, as used in marking lambs, could also be used for this purpose.

With initiative, "know-how" and skill, New Zealanders must apply themselves to the challenge of inventing a new and successful identification method for sheep other than brands.

By trial and error the problem of identification of New Zealand's sheep will undoubtedly be overcome so that in the future the wool buyers of the world can be confidently invited to purchase, for the first time, an annual New Zealand clip of brand-free wool.

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TREES AND RAINFALL

A. E. ESLER*

MANY TIMES in the past there has been debate on the effects of trees on rainfall. With every drought in New Zealand, someone is bound to say privately, or in public, that the recurring drought problem would be solved if more trees were planted. The purpose of this paper is to examine the basis for this assumption, and to draw what conclusions can be drawn from the growing literature in this field.

It is well established that forests locally affect air temperature, air humidity and wind velocities but these influences do not extend far from the forest margins. The effects on rainfall have been difficult to determine. In some circumstances at least, forests receive more rain than adjoining grassland by promoting condensation and by intercepting fog. In many coastal areas, particularly in Japan and California, this accounts for an appreciable proportion of the total rainfall, but this benefits only the forest. Comment will be confined to the possibility of tall vegetation increasing precipitation significantly over adjoining grasslands.

Experimental Evidence

Investigations in this field date back for more than a century. They began in Europe in 1858 using paired recording stations, one in forest, one in grassland. Later in India rainfall over a period before deforestation was compared with rainfall after felling. In the United States a more satisfactory method using a combination of both of these was developed. A mass of literature from many parts of the world has appeared. All research workers have faced the difficulties of making true comparisons. For example, to obtain comparable sites for recording stations is nearly impossible; to gauge rainfall accurately is equally difficult. Many authors have shown slightly higher rainfalls over forested areas but have failed to demonstrate convincingly that the effects extend beyond the forest boundaries. Perhaps experiments cannot reveal the facts whereas the theoretical basis may do so.

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Theoretical Basis

Precipitation of rain is regulated by the supply of moisture in the atmosphere and the factors which cause it to fall as rain.

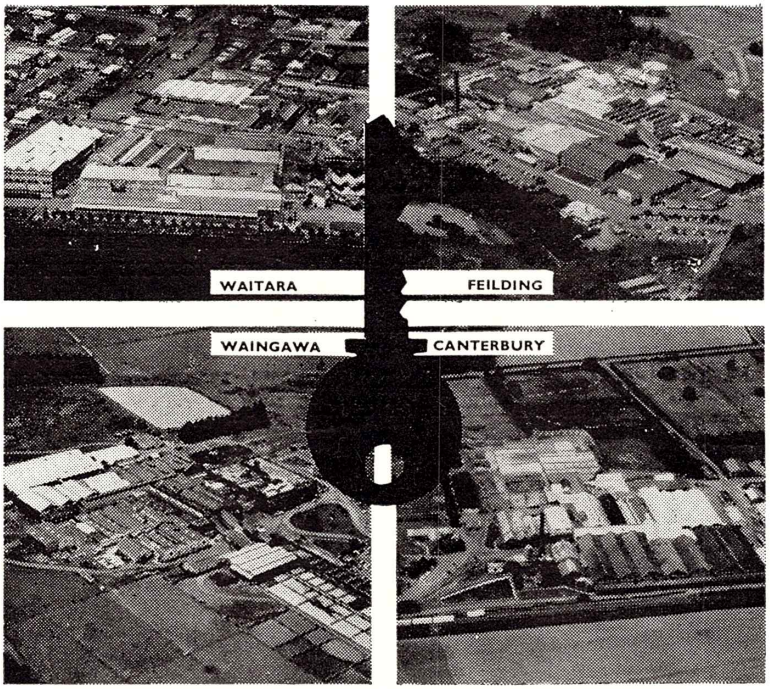
Water reaches the atmosphere by many paths. Some is evaporated from open water surfaces, some from intercepted rain on plants. From the soil, water is lost directly by evaporation and indirectly through plants by transpiration. These are usually considered together as evapotranspiration because of the difficulties of measuring them separately. Loss by evapotranspiration is governed to a large extent by the supply of soil moisture available to different plants,by the amount and colour of the foliage and by meterological factors. Forests tend to use more water than other types of vegetation. Because of their deep root systems, trees have more water available to them while shallower rooted plants may be suffering a water deficiency stress. The darker foliage, too, promotes greater transpiration. As a consequence, air above forests is nearer saturation and more easily precipitated. However, because of winds, water is seldom precipitated where it is absorbed by the atmosphere. Water evaporates about one-and-a-half times as freely from open water surfaces, but is rainfall higher over the sea than it is over land? In an insular country such as New Zealand the amount of moisture lost from vegetation — be it forest or grassland — is very small compared with evaporation from the oceans which contain 97% of the world's water. Lack of atmospheric moisture is not a cause of droughts.

What then causes precipitation and what part do trees play? Precipitation is primarily the effect of cooling a mass of vapour in the atmosphere below its dew point. Usually this cooling is brought about by the rapid ascent of air to give cloud, and later rain, if the cooling continues. The ascent is brought about in three main ways. First, by upward deflection as it climbs over elevated land — this gives *orographic* rain; secondly, by upward deflection as it passes over cooler, denser air — *cyclonic* or *frontal* rain results; thirdly, by updraughts created by local heating of the earth's surface to give *convectional* rain.

Trees increase the height of the land barrier causing the ascent of air and some turbulence. It is estimated that this may increase local rainfall up to 2%, *i.e.*, may add half-an-inch per annum to a 25 in. rainfall where the total precipitation is mainly orographic. On the other hand, frontal

systems move on such a large scale that differences in vegetation, or even the presence or absence of vegetation, has no significant effect on rainfall. Convection currents arising as they do from local heating of the earth's surface are influenced by vegetation. Land under sparse vegetation heats quickest and most to produce favourable conditions for convection. As vegetation density and height increase, conditions become less favourable. Thus forests tend to reduce convection and convectional rain.

All the evidence seems to point in one direction — under natural conditions, forests are a result of rainfall, not a cause of it, and no useful improvement should be expected in either the total rainfall, or seasonal spread, by planting trees.



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HOW SHEARING AFFECTS THE WOOLCLIP

A. E. HENDERSON*

PROCESSING OPERATIONS which transform a mass of wool fibres into yarn and fabric are very much influenced by thickness and length of fibres and by differences of length and thickness among fibres in the mass being handled.

For a variety of reasons growth of wool is not constant from month to month and for other reasons there is great variety in the period wool is allowed to grow before it is clipped and in the time of year when it is clipped. A combination of all of these circumstances has a profound influence on the woolclip and the extent of this is not generally realized. The particular reason for this lack of understanding is because the rather spectacular shift of shearing times from the old conventional November/December has been motivated not so much by a desire for a better woolclip but chiefly by other things. Of these the most important has probably been the stock management factor. Also, to some degree, the timing of income can be considered a fairly important management factor.

The spread of shearing from the November/December period began seriously when some farmers in South Otago and Southland adopted the practice of shearing pregnant ewes in August. It is some thirty years since this started in a very small way. Fifteen to twenty years ago there was a rapid spread of pre-lamb shearing throughout the whole of the South Island. The proportion of sheep that are now pre-lamb shorn is not known and although the practice is widespread it probably involves fewer than 25% of breeding ewes in the South Island. It seems too that few pregnant ewes are shorn in the North Island.

Starting about 1950 two more variations were introduced into shearing practice. Some farmers decided to shear twice in the year and others decided on shearing at eight-month intervals. It has always been assumed that high wool prices were the main factor behind the start of what is commonly called double shearing. Whether this is true or not there is no doubt that farmers quickly realized that there were some managerial advantages attached. With the establishment of what seems to be a sound market for short wools, it is clear that the practice is here to stay.

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* Professor of Wool Science, Lincoln College, Canterbury.

Shearing three times in two years has a somewhat different background. With improvements in stock health, and with better pastures, well-bred sheep in the more favourable locations are able to grow a very heavy fleece. Under these conditions a satisfactory fleece from the processing point of view can be grown in under 12 months and besides there is no virtue in forcing a sheep to carry about a very heavy fleece. One further point is that pre-mating shearing of two-tooth ewes in February and March fits in well with shearing every eight months.

The wool produced by this multiplicity of shearing operations has been and is being successfully marketed. The inference is that wool of a wide range in length can be successfully absorbed into the trade. Considering only the wools shorter than full staple length, it is therefore difficult, or indeed impossible, to arrive at any conclusion as to what is the best length for short wools. One may conclude, then, that the main interest of the producer should lie in quantity, colour and preparation of the clip. While this is substantially true, some part of any difference in price is caused by things such as the relationship of fineness and length and this cannot be left out of consideration.

The specific effects of shearing on the woolclip can be divided into different categories. There are direct effects on the fibre, there are effects connected with the relationship of the fleece and the environment, and there are indirect effects on wool growth arising because of physiological adjustments within the sheep made according to the state of growth of the fleece.

Direct Effects of Shearing

Of the direct effects, possibly the most controversial — and probably also one of the least important — is the question of whether the simple act of cutting, or in this case frequent cutting, has an effect on the fibre. No evidence is known which shows that it does. A wool fibre is made of hard fibrous tissue, it is not alive in the popular sense of the word, and it has a remarkably constant chemical composition along its length. It is therefore difficult to believe that cutting or the way it is cut would have any effect.

By far the most important direct effect concerns the *place* at which the fibre is cut. This is brought about by the different rates of growth of fibre in different months of the year. Some years ago Story and Ross made detailed measurements of month-to-month wool production of Romney

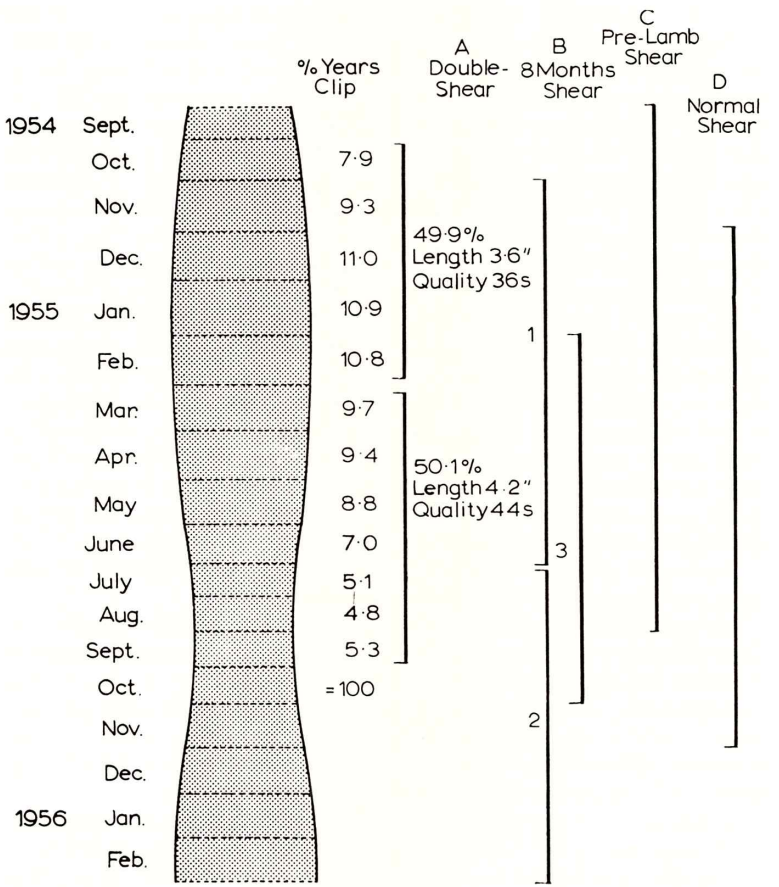

Fig l; Growth rate of wool fibres and shearing

breeding ewes running at the Invermay Research Station. The kind of fibre grown by these sheep, which are similar to most of the sheep that are shorn more than once in the year, is shown in Fig. 1. In this figure there are a number of points of interest to consider.

First, if production in the months for which two sets of production figures are available, that is September to February, are compared, it will be noted that relative monthly production rates vary from year to year. The main

causes of this will be feed supplies, climate, and the number of lambs being reared. However, the most important thing to note is the very different wool production rates from month to month. The highest production occurs close to the month of February and the lowest production is close to the month of August. Highest production is almost three and a half times that of the lowest production. A similar pattern of wool growth in crossbred and Corriedale ewes in Canterbury has been described by Coop and by Hart. For these sheep slightly less extreme maximum/minimum ratios of approximately 3 to 1 were found.

Attention can also be drawn to the slow rate of length growth in July and August and this will be referred to later in connection with physiological adjustments following shearing. It will be noted, too, that thickness of the fibre at its widest part (February) is approximately one and a half times its thickness at the narrowest part (August).

It is obvious that the places at which this fibre is cut during shearing will have an important effect on the shape and average thickness and length of fibres in the clip.

Four possible shearing programmes, all of which are in use, are shown in Fig. 1.

An example of double shearing (twice in 12 months) is shown under A. It has been arranged so that equal amounts of wool are shorn at each time. But it will be noticed that the summer clip for five months is half an inch shorter and two qualities (or counts) coarser than the winter clip. Greater differences are found if the summer clip is confined to November-February as is often the case.

A convenient pattern of shearing at eight-month intervals is shown under B. Such a shearing programme will give fibres that are thick at one end and thin at the other. But this is no particular handicap except perhaps that the first and third clips will have a coarse tip and finer butt and the second a fine tip and coarse butt to the staple. This might influence valuation of the wool.

The kind of fibre produced when sheep are shorn annually in the early spring (pre-lamb) is shown at C, and that obtained with the conventional summer to summer shearing at D. The shapes and dimensions of fibres in these two clips are obvious.

A common factor that can be associated with shearing programmes A, B and D if a shearing takes place in summer is coarse hairy tip. This will only occur in sheep with an inherited ability to produce medullated fibre. This is the so-called hairy fibre which typically has a central core of

large fragile cells. In most sheep able to produce this kind of fibre, it is produced only in months of high wool growth or if some other powerful stimulus is provided. This being the situation, it is likely that it is the wool grown from November to March that is most affected. Unless there is a high percentage of this kind of fibre, there is no price discrimination against it and if carpet wool supplies are in demand it may even be worth a premium.

A similar but very much shorter production of medulla may be brought about by the very act of shearing. This is, more correctly, an indirect effect brought about by physiological adjustment within the skin. It is apparently provoked by lowered temperatures because it does not happen if the skin is immediately covered so that it is kept warm. A combination of this effect and the marked stimulation of wool growth that occurs about November is often sufficient to cause pronounced harshness of the tip in fleeces grown after November shearing. Remember, however, that this only happens in sheep with the inherited ability to produce medullated fibre. It certainly does not happen in all sheep.

The commercial significance of differences in these wool-clips is not clearly apparent if judged by prices obtained. Part of the reason for this is because the different clips are used in different ways. The only clear indication available is that very short coarse wools have a more limited use and fetch a lower price than wools of reasonable length.

Indirect Effects of Shearing

It can be generally conceded that shearing times appear to be dictated more by preferences in farm and flock management than by ambition to have a particular kind of wool to sell. Some of the management practices associated with shearing have a considerable influence on the clip, particularly in the matter of weight, and must be taken into account.

In this connection the possibility of stimulation of wool growth by shearing is a familiar subject of discussion. There is a popular conception that frequent cutting of hair or of wool will stimulate growth. The evidence is that the first time it happens there is probably some stimulation but it is so very small that it cannot be measured and it therefore is of no practical significance.

Lack of direct response to shearing must be reconciled with the common experience that sheep frequently grow more wool after shearing or following repeated shearings.

But they sometimes grow less and the indirect causes of this must be found.

The most simple explanation is that the changes in wool growth result from changes in the amount of food consumed and in the demands made on this food following shearing.

Immediately after shearing, several fairly profound physiological adjustments have to be made by the sheep. Since the fleece is a very good insulator, and it need be only just more than half an inch long to provide more than three-quarters of the possible insulation of a full fleece, shearing with machines which leaves something like 1/5 inch of wool will very substantially increase the chance of heat loss from the body. This is accentuated by wind and rain, with wind being the more important of the two.

For example, Coop and Drew found that shearing in autumn increased the maintenance requirement of sheep by 20 to 40%. Further, if the shorn sheep has to work hard at grazing a very short pasture, its maintenance requirement will be between 40 and 50% higher than that of a shorn sheep grazing long pasture. Immediately after shearing the skin commences to thicken. The physiology of this is not very well understood, but a noticeable thing about it is that shivering lessens as the skin thickens. Secondly, and more important, there is an immediate increase in appetite. At its peak a few days after shearing this may be 40 to 50% more than before shearing, but this elevated appetite persists for only a short time and has disappeared in approximately four weeks according to Wodzika-Tomasewska.

At this point it is appropriate to recall three important principles of wool growth. One is that a sheep will still produce wool but in lessening quantity as it is losing weight. The second is that, the more surplus food there is above the maintenance requirement, the greater the quantity of wool that will be grown. And, thirdly, there is the fact that wool growth responds very quickly to changes in level of feeding.

If these principles are considered, together with the physiological stresses associated with shearing and which are accentuated by bad weather, the conclusion must be reached that, except in the very hottest months of the year and during good weather, newly shorn sheep must be allowed to eat more simply in order to *maintain* wool production rates. If they are expected to show an increase in wool production after shearing, then they must be allowed to satisfy fully their temporarily high appetite. This appears to be higher than is required for increased maintenance so

that there can be some surplus for body weight gain and increased wool production.

In the few detailed trials of twice-yearly shearing, some have shown that more, and some that less, wool is grown than if the sheep had been shorn only once. Feeding in the month immediately after shearing would appear to be the chief cause of this variation, and of course cold or bad weather provides a complication which would reduce the effects of good feeding and accentuate the depressing effects of mediocre or bad feeding.

Before leaving this point, it is well to recall that, if sheep are machine shorn during the months of naturally low wool production, length growth rates are so low that it takes much longer for the fleece to reach a length sufficient to provide reasonable insulation. If there is to be no loss of production following shearing, it seems imperative that sheep be shorn with a snow-comb or with blades in these months.

Interaction of Fleece and Environment

Regarding the interaction that occurs between the fleece and the environment, there are several obvious advantages of the short fleece. One is that the extent of weathering is much less because the maximum time any wool is exposed to the damaging effects of sunlight is perhaps seven or eight months. Usually loss of wool by weathering is substantial on open-woolled sheep such as the Romney and particularly in districts with frequent rainfall and intense sunlight. Twice-yearly shearing in these districts will certainly produce a less damaged fibre and will also ensure that less fibre substance is lost over the period of growth. A similar saving action is performed by sheep covers.

The most important aspect of fleece-environment interaction is wetting and drying behaviour. It is well known that many wool faults, particularly yellow staining, are caused by prolonged wetness of the fleece and it is obvious that the shorter the staple the more quickly a fleece will dry. Rates of wetting and drying of fleeces are complex things to explain because of the variable nature of rainfall and drying conditions and no one situation can be claimed to be ideal.

However, it is worth while to describe several typical situations. Although pink tip appears not to be a very important wool fault, it nevertheless draws attention to and is

associated with, wool damage and loss. It seems not to occur unless there is at first damage to the fibre tip and subsequently the weather is both damp and cold. Normally, double shearing does not allow sufficient initial fibre damage for the fault to develop. The same may be true also of black fungus tip.

A fault of great importance in New Zealand wool is what is commonly called canary yellow. This is a diffuse and unscourable stain which occurs only when the fleece is wet, temperatures are high and there are highly alkaline conditions within the fleece. The three conditions must apply together before the fault will develop. Nothing can be done about rainfall or air temperatures but if the fleece is short a reasonably high proportion of alkaline substances are washed out of the fleece by rain and the fleece will usually dry fairly quickly. In addition, the temperature gradients within a short fleece are liable to be rather different from those in a long fleece. These conditions in the short-stapled fleece are nearly always sufficient to prevent canary yellow staining.

On the other hand, there are some situations in which the short fleece is at a distinct disadvantage. Being short, it wets to the skin very easily and quickly. If for nearly a week or more there is no opportunity for it to dry, a number of things may happen. A superficial inflammation of the skin may develop. Following this an exudate is produced and frequently there is extensive multiplication of micro-organisms within the exudate. In any case, a band of yellowish material will appear in the fleece and while the condition is active it may be slimy and foul smelling. Sometimes colour-producing bacteria may be present and if so the fleece may be stained in bands of green or brown and, much more rarely, blue. The occurrence of bands of exudate is much more common than the green or brown stains but neither can be considered typical of short wools. In general considering the relationship of double shearing and high rainfall, the evidence favours double shearing. In some circumstances it can cause trouble, but in most it provides for faster drying and less fleece damage.

There is another important factor through which indirect effects may be produced in the fleece. A fleece 3 in. or more in length will, when wet, hold a considerable weight of water and there is no doubt that a heavy wet fleece is an encumbrance. The thrift of sheep subjected to these conditions is liable to suffer and there is a consequent effect on wool growth. Under difficult conditions, whether these be

caused by climate or topography, and provided there is no undue stress at the time of shearing, it is common experience that more wool, and wool of a better style and colour, is produced if the sheep is not allowed to carry a very heavy fleece.

In flocks that have a very high individual production — and these are most often stud flocks — shearing at about 8 months' growth provides a very acceptable kind of wool, often equal in staple length to the average 12 months' fleece. It should be remembered that it is possible to have wool overgrown and in this state the fibre length is greater than required by the manufacturer and the fleece is very subject to faults associated with dampness. There is no doubt that 8-month shearing is acceptable if wool is well grown. But, if practised in low-producing flocks, it may result in the clip being rather out of line with market requirements.

The Pre-lamb Shorn Fleece

Lastly, it is worth considering the pre-lamb shorn clip since this is simply a variation of a full 12 months' fleece. Pre-lamb shearing was the first alternative to conventional summer shearing and it undoubtedly produces a radical change in the nature of the clip. In brief, the pre-lamb shorn clip is almost invariably sound, the colour and style is much better than a summer to summer clip, and there is a virtual absence of cotted wool. The act of shearing does not effectively alter the typical month-to-month pattern of wool growth, so there must be other reasons for the change.

Soundness of the clip results from the fact that the fibre is cut through at its thinnest regions. While this is a good thing it means, however, that the tip of the next fleece is generally fine and open and for this reason it may suffer rather more weathering than a fleece previously shorn in summer.

Style of the pre-lamb shorn clip appears better because crimp expression is not disrupted at some point away from the ends as it almost invariably is in the summer fleece.

The distinctly better colour of pre-lamb shorn wool requires more involved explanation, but basically it is due to the fact that the fleece is short and easily dried in the spring and early summer when most discoloration occurs. The full fleece at this time is most difficult to dry.

The striking absence of cotting is a distinguishing point of all pre-lamb shorn wool, but this does not mean that it does not occur if sheep are shorn in very early spring. If

cotting is present in a fleece, it is virtually at skin level during very early spring. Shearing takes place over the top of the cotted layer and subsequently this is pushed outwards by new fibre growth. Very often this cotted layer will strip off and a substantial amount of wool can be lost, or, alternatively, the cotted layer remains at the staple tip of the new fleece. What actually happens to this wool will depend on the seriousness of the break and cott.

Conclusion

No doubt times of shearing and the interval between shearings will continue to be dictated by convenience of management, both stock management and management of finance. But whatever dictates the shearing programme, the importance of producing a commercially acceptable woolclip cannot be too firmly realized. Since clips produced over a few months' growth require different handling and market preparation from those for full-length clips, attention to clip preparation cannot be neglected.

Attention can be drawn, too, to the very high feed cost of satisfying increased maintenance and higher appetite of newly-shorn sheep. It is conceivable that close shearing during the colder months of the year, while it may satisfy a small convenience of management, may in fact be so costly when measured in relation to high feed costs and lowered production that it is indeed bad management.

There are many possible combinations of shearing times. The main effect of any chosen programme on the woolclip can, with reference to the fibre growth diagram given in Fig. 1, be predicted. But all the subtle variations that can be induced by interaction of fleece and climate and the balance struck between current needs of shorn sheep and the feed available and weather conditions, are to some extent matters of chance. Sometimes they can be foreseen, and sometimes they can be predicted for a particular district. But the continually changing ranks of those using one or other shearing programme seems to indicate that the real worth of any particular programme is quite difficult to foresee.

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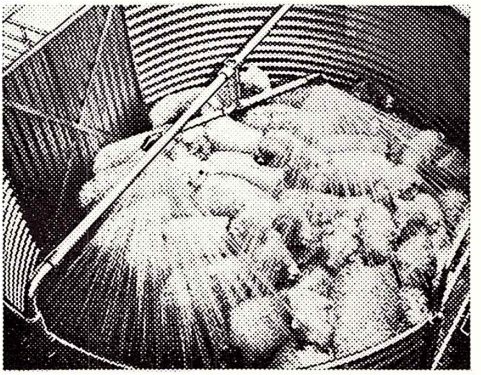

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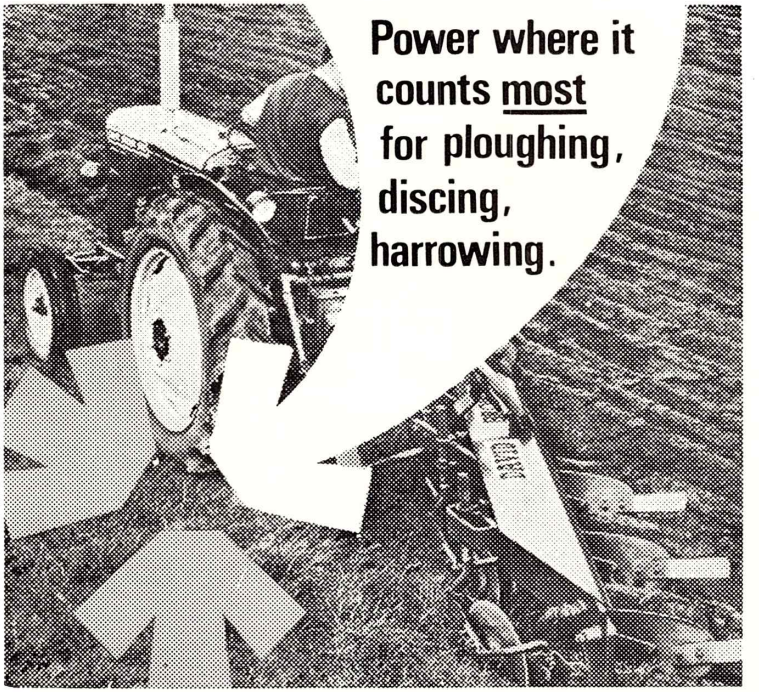

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QUALITY IN CATTLE AND BEEF — A CHANGED CONCEPT

R. A. BARTON*

QUALITY can be regarded as an indefinable something which appeals to the wealthy and discriminating buyer and for which he is prepared to pay well. It therefore has a monetary value and an appeal to some; it dominates the cattle-breeding policies of many but it is seldom related to the productive worth or merit of the animal. It may have an attraction to man's sense of beauty and art but it is essentially divorced from reality. It is fashionable and hence transitory; here today and gone tomorrow. It appeals to the elite and for them quality is regarded as a status symbol which sets them apart. It is essentially an unattainable and elusive attribute, but for those whose animals approach the highest quality it is found that quality pays. The premium for high quality, however, places the article beyond the means of the rank and file of the mass market.

Quality is what some pedigree cattle have and most non-pedigree animals do not have. Registered cattle with quality developed to a high degree frequently top the stud sale by many hundreds of pounds; quality run or commercial cattle fetch at most a pound or two more than good-average sorts; the cooked beef from the quality animal may be quite indistinguishable from that of the average. Mainly because of this, there is no premium paid for first-quality ox beef in current New Zealand price schedules. Thus it would seem appropriate, in view of these facts, to examine closely the need for, and meaning of quality in the live animal, its carcass, and in the cooked beef.

Quality in the Live Animal

Breeders and judges of stud cattle take into account a number of factors which they believe are indicators not only of quality in the animal but also of quality in the flesh. Much attention is paid to the shape of the head, the prominence and alertness of the eyes, the width between the ears and the eyes, and the width of the muzzle. The softness and fineness of the hair, the pliability of the hide and general refinement of the animal are also regarded by judges as indicators of quality. Coat colour and markings, conformation and general symmetry of the animal are additional

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factors which are taken into account when assessing quality, as also is size and shape of the horns and leg bones. The tail and its switch may even be considered in evaluating quality.

Quality in non-pedigree or commercial cattle is usually assessed by considering the evenness of the line of animals in terms of size and colour, general conformation of the individuals, with emphasis on width and blockiness of body and relative shortness of legs. An appearance of being "choicely bred" adds to the apparent quality of the line. The aesthetic details contributing to quality in the pedigree animal are not necessarily looked for or required in the commercial animal, however.

The show and sale ring, the stud breeder and the breed societies have all played a part in creating standards of quality and this, in turn, has resulted in placing quality ahead of productive worth as a hallmark of excellence in meat animals. Quality and productive worth have thus become separated and the gulf between these is wide. If emphasis could be placed on those factors which have real value affecting the production of the animal, progress will be made. Animals of the highest production would then become the admired and favoured ones and quality standards would change to place these animals in the topmost position. At present there is bound to be an antagonism between what is regarded as high quality and what is needed in an animal to make it fully productive.

It needs to be pointed out that the characteristics of hair, hide, bone, horn, muzzle, eyes, ears and coat colour and markings have never been found to be related to quality in the carcass or its meat. Even show ring standards of conformation in the live animal bear little, if any, relationship to yield of red meat or of the proportion of high-priced to low-priced cuts.

Most of the quality factors looked for in the live animal are really indicators of its health and the way it has been fed, or housed, groomed and trained in the case of show cattle. This is where the art of the herdsman comes in. It is true that shape of the body will be controlled to a degree by heredity, as also will coat type and colour, but even these attributes can be influenced or altered by man during preparation of the animal for show or sale.

Quality and Size of Animal

It is well recognized that animals of medium to small size are regarded by the judges as having more quality than

larger animals. The principle here is that a fault in a large animal is more obvious than the same fault in a small animal. The small animal is also considered to be more refined and is more likely to have "a sweet head" or some other feature which appeals to those seeking animals of so-called quality.

Cattle of small size are not wanted by the commercial man. He wants animals of medium to large size and weight as cattle of this kind are known to have higher calving percentages, grow faster, have less fat, and their carcass quality and cut-out yield are at least equal to and may often be superior to those of smaller-type cattle.

Stud breeders in Britain have long favoured the smaller beast, as is revealed by the decline in weights of animals exhibited at Smithfield show. Fortunately some breeders in New Zealand are now aware that it is a mistake to breed for smallness and they are seeking larger cattle to remedy the errors of the past.

Emphasis on small size as a quality factor undoubtedly contributed to a greatly increased incidence of dwarfism in the Hereford, Aberdeen Angus and Shorthorn breeds in America. Some dwarf calves have been born in New Zealand stud herds and these can mainly be traced back to imported stock of recent origin. The catastrophe of dwarfism helped greatly to make American breeders aware that small, compact-type cattle should be avoided even though animals of this kind had earlier been regarded as ideal and had won many awards at leading shows.

According to one survey in Scotland, it was noted that some Aberdeen Angus bulls with present breed standards of body conformation and size were experiencing difficulty in mounting and serving cows. Cattlemen in New Zealand have also observed bulls having similar difficulty and have regarded this as the result of the short legs and small rotund body type of these bulls.

Feet of Cattle

Many present-day cattle have feet which are far from satisfactory. Attention in breeding and in the show and sale ring has not always been placed on this important feature and consequently the incidence of defective feet appears to be increasing. Some emphasis in judging is rightly given to the placement of the legs and the action of the joints, especially the hock, but even so many bulls walk very poorly.

What Factors are Important in the Live Animal?

In assessing the live animal what should be taken into account?

First and foremost the beast must give the impression of being able to fulfil its function of producing efficiently under the conditions in which it will be kept. It must be a "practical beast" in the sense of possessing well-developed traits of economic value without undue development of fancy show points.

Specifically this means that the animal must have legs and feet which are structurally sound, correct jaws and teeth, a body size compatible with the environment, market needs and productivity, and a coat type which allows maximum heat dissipation in the summer and protects the animal in the winter, and a coat colour which will absorb less heat from the sun in summer. This desirable animal will have the kind of conformation that adds to carcass desirability and structural soundness. Those items of conformation that contribute to carcass desirability will include thickness of muscling or natural fleshing (not fat) particularly in those parts of the animal that produce the cuts of most value such as the back, loin, rump and round or buttock and the amount of outside fat relative to muscular development. The items of skeletal structure and soundness which may contribute to longevity are those related to the correctness of the basic build of the animal — its legs and feet, back, neck, rump and pins.

Many of the features of the body which are stressed as valuable quality or breed characteristics are in fact regarded as defects by the carcass judge. For instance, the full and deep brisket, the level underline, the flat and wide back, the smoothly set-in shoulder, the well let-down crutch, the deep and full flank, and the well-filled cod, are all indicators of a beast which is already far too fat for modern requirements. It is true that lumpy or patchy deposits of fat are less noticeable in present-day show-winners; the breeder has apparently been successful in smoothing out these fatty accumulations so that today the animal has a much more even layer of fat under its hide. This does not mean, however, that the modern animal has less fat than its predecessors. It should be borne in mind, too, that for every pound of fat on the outside of the beef carcass, there are about two pounds between the layers of red meat.

The live animal judge places emphasis on the "handling quality of the flesh" in the belief that this will indicate the

probable eating quality of the meat. Even a mossy, velvety coat is considered to denote high-quality fleshing. No factual information is available to support these beliefs, but it would be surprising if there was any relationship between coat type or handling qualities of the live animal and the eating qualities of its flesh. In fact, the "mellow handling flesh" so prized by judges probably reflects the pliable nature of the hide and the amount and type of fat under the skin rather than any intrinsic quality factors present in the red meat.

Live Animal and Carcass Contests

Farmers and others who attend competitions where the animal is judged alive and later its carcass is appraised will have noticed that the placings of the "on hoof" and the "on hooks" entries seldom, if ever, coincide. The "on hoof" judge has a most difficult, if not impossible, task to determine with accuracy how the carcass when hung up will appeal to the "on hooks" judge. The judge of the live animal cannot tell the colour of the muscle or fat, the precise distribution of fat over the carcass, or the amount of internal fat, the area of the ribeye at, say, the 12th rib, or the development of marbling fat within the ribeye muscle. When hung up, the whole aspect of the carcass and its centre of gravity are completely changed from what it was in the living animal so that a weakness, for example, in the loin or buttock of the carcass may not have been apparent in the live animal. And, of course, the "on hoof" judge may be wrong in his estimate of carcass weight to the point where a placed animal is rejected for being outside the weight range specified in the conditions of the competition.

It is imperative for the "on hoof" judge and the "on hooks" judge to know what each is attempting to assess. In general, neither knows much about the things considered important by the other and until this obvious deficiency is rectified the disparity between the two will remain.

Carcass and Cuts Judging

Recently, a new competition has been introduced involving the judging of cuts of beef. This brings the judgements closer to the needs of the consumer than was ever possible before, when only the ribbed side of the carcass was appraised. Even in this competition the carcass judge's placings may not coincide with the placings of the cuts judge, probably because the cuts judge has the advantage

of knowing the weights and values of the trimmed cuts and the amount of waste fat and bones. He also measures objectively certain attributes of the meat. The greater precision and realism in judging cuts as against judging the carcass or the live animal is clearly in its favour. From an educational point of view, meat cuts competitions are much more valuable and pertinent than the more usual kind of meat-animal competitions.

Quality in the Carcass

There are two basic factors that determine carcass merit. First, the proportion of the carcass that is edible and, secondly, the palatability-indicating characteristics of the lean.

What are the main factors which affect the proportion of the carcass which can be eaten? The meat trade refers to this proportion by such terms as the yield, cut-out value, cut-out yield, or cutability, and it is expressed either as a unit or as a percentage. The trade evaluates a beef carcass in terms of its percentage of trimmed, boneless retail cuts, that is, its edible portion or edible meat content. The excess fat, bones, tendons, etc., comprise the non-edible or waste portion of the carcass. It follows, then, that a carcass with a low percentage of waste, including fat and bones, is a more profitable carcass and is one which requires less time in preparation for sale over the counter since there is less trimming needed. Such a carcass will be regarded as one with quality because it is superior, more desirable, and more profitable.

Factors Affecting Cutability of the Carcass

The preference of the modern consumer for lean meat has made it desirable to identify beef carcasses with high yields of lean meat. As a consequence of this consumer demand, the concept of cutability has been developed and incorporated into the grading systems of Otago and Southland and in the U.S.

The cutability of a carcass is largely determined by four factors. These are:

(1) The amount of external fat on a carcass. This is evaluated by measuring the thickness of this fat overlying the ribeye muscle at the 12th rib. It has been found that, as the amount of external fat increases, the percentage of retail cuts decreases. Furthermore, it has

been shown that the amount of fat present in the carcass is 4½ times more important than conformation as a factor affecting cutability.

(2) The amount of kidney, pelvic and heart fats in the dressed carcass. As the proportion of these fats increases, there is a decrease in the yield of retail cuts.

(3) Area of the ribeye muscle at the 12th rib. The area of the ribeye has a slight positive relationship to the yield of trimmed retail cuts.

(4) Carcass weight. As carcass weight increases, the percentage of retail cuts in the carcass decreases. Thus for every 100 lb increase in carcass weight there is a decrease amounting to 40% of a yield grade.

When these four factors of fat thickness, kidney, pelvic and heart fat, area of ribeye and carcass weight are jointly taken into consideration, it is possible to determine, with a high degree of accuracy, the cutability or yield of trimmed, boneless retail cuts of beef.

Yield Grading of Beef Carcasses

Many New Zealand first grade (G.A.Q.) ox beef carcasses have 20% or more of fat trimmed off before the cuts can be packaged for export and even then ⅜ in. to ½ in. may be left on certain cuts. The influence of fat on cutability can be demonstrated when it is realized that a 470 lb carcass with a 10.5% fat trim will yield as much edible meat as a 500 lb carcass with a 30% fat trim. The value of the trimmed off fat is worth about 2d. a pound. In view of this, it is reasonable to expect meat exporters to be in favour of extending the yield grading of beef throughout the country. At present the provinces of Otago and Southland have such a grading system and it has met with the approval of producers, drafters and exporters. The producers receive a premium price for the highest-yielding carcasses and this is having a beneficial effect on the quality of the beef produced in these two southern provinces. If this, or some similar system of beef carcass grading was employed throughout New Zealand, it would be the most progressive step ever made to encourage the production of beef of the kind all markets require. A more comprehensive yield grading system is in operation in the U.S., and as far as Great Britain is concerned the Verdon-Smith report recommended a beef carcass grading procedure based essentially on yield of cuts or cutability.

When assessing carcass merit or value, it is necessary to consider both cutability and meat quality. In the United States the price levels in 1963 for their Prime, Choice, and Good grades were such that a 2% change in cutability had approximately the same influence on carcass value as a change from one grade to the next grade. In other words, this can be expressed by stating that 2% cutability is equal to one quality grade. There are essentially only two grades for beef carcasses in New Zealand, namely, first (G.A.Q.) and second (F.A.Q.), but there is no schedule price difference between them. Even within a grade, the yields of trimmed, boneless cuts will vary by 15% or more but yet under current price arrangements the producer receives the same price for every carcass in a specified grade. Cutability rather than quality therefore should be the major factor determining carcass value of New Zealand beef.

Influence of Fat and Carcass Weight on Cutability

The factor exerting the most influence on cutability is fat content of the carcass. This is why fat thickness over the ribeye, the internal fats and carcass weight are three of the four factors taken into account in estimating cutability. In this connection it should be mentioned that there is a close positive relationship between carcass weight and fat content; heavy carcasses have more fat than light carcasses.

Ribeye Area and Cutability

The fourth factor taken into account when predicting cutability is the area of the ribeye. This measurement, however, is not particularly important because of its poor relationship with total red meat in the carcass. Furthermore, a large ribeye at, say, the 12th rib does not mean that the same muscle will necessarily be large at other locations along the back. The ribeye also varies considerably in shape and in its marbling fat content within a carcass.

Carcass Conformation and Cutability

Cutability is influenced to only a small degree by the conformation or shape of the carcass. Thus carcasses in the poorer grades may have higher cut-out yields than those in the so-called better grades. Carcasses from dairy-bred steers, such as Friesians, will have yields of trimmed boneless cuts which are as high and perhaps even higher than beef-bred steers. Accordingly, the red meat content per 100 lb carcass weight may be higher for Friesian steers than beef-bred steers. This has been found to be the case in several experi-

ments and it indicates two things. First, dairy-bred cattle have less fat than beef-bred cattle when each type has been fed together and, secondly, the inferior conformation of the dairy-bred animal does not imply that it will have less red meat in its carcass.

When palatability studies have been carried out involving beef from dairy- and beef-bred cattle of comparable age, sex and management, no important differences in the eating qualities between the two types have been noted.

Carcass Conformation and Grading

Like most beef-producing countries, New Zealand grades take conformation strongly into account and those carcasses showing ideal conformation are praised as being of top quality. The U.S. Department of Agriculture Grading Service, on the other hand, has serious doubts about the importance of conformation and, in its dual-grading system introduced for a trial year in 1962, beef carcasses were graded for both quality and yield — hence the term dual grading. In that grading system, conformation of the carcass was ignored. Just recently (effective on June 1, 1965) the U.S. Department of Agriculture has introduced a modified quality and yield grading system in which conformation is considered to a very minor degree and only to satisfy "several segments of the industry". The Department in this connection states that: "Its [the term 'quality' referring only to the palatability-indicating characteristics of the lean without reference to conformation] use herein to include consideration of conformation is not intended to imply that variations in conformation are either directly or indirectly related to differences in palatability."

The U.S. Department of Agriculture Grading Service defines superior conformation in this way: "Superior conformation implies a high proportion of meat to bone and a high proportion of the weight of the carcass or cut in the more valuable parts. It is reflected in carcasses and cuts which are very thickly muscled, very full and thick in relation to their length and which have a very plump, full, and well-rounded appearance."

Conformation, Carcass Composition and Cattle Breeding

Some very enlightening research into certain aspects of conformation has been undertaken in Queensland by Butterfield. He has dissected out the individual muscles of over

70 carcasses representing Poll Hereford, Hereford, Aberdeen Angus, ¾ Brahman ¼ Hereford, ½ Brahman ½ Hereford, and unimproved Shorthorn cattle. Although there were extreme differences in conformation between the various breeds and types of cattle, Butterfield found no worthwhile differences between them in the proportions of expensive to less-expensive muscle regions. The Herefords had 55.59% of expensive muscles in their carcasses which was the lowest figure, while the ½ Brahmans had the highest proportion of expensive muscles, namely 56.84%.

From this study Butterfield concluded that the efforts by breeders to improve the distribution of muscle weight over the carcass have been unproductive. Related to this question, Warwick — who is in charge of beef cattle research in the U.S. Department of Agriculture — made the following pertinent comment: " . . . it, thus, appears to be quite definite that if hereditary differences in the percentages of high-priced cuts do in fact exist, they are not closely related to the factors most of us have been taught to look for in evaluating the external appearance of beef cattle".

A great deal more evidence could be presented to indicate that emphasis on conformation down the years has largely been misinformed as conformation is neither a good indicator of yield of red meat nor of eating qualities of the flesh. Not all segments of the beef industry will accept immediately these well-documented findings since to do so would mean discarding long-held and firmly entrenched ideas and beliefs. Nevertheless, when well-established evidence is placed before the industry, it is vital for its well-being and future progress for this new knowledge to be readily accepted and acted upon by all concerned.

Quality in Meat

Meat quality is usually thought of in terms of those factors that contribute to eating satisfaction and those that make an appeal to the customer at the point of sale. Characteristics such as tenderness, flavour, juiciness, firmness, and texture of the flesh, and the colour of the fat and lean are considered to be important.

Tenderness

Next to leanness in meat, the consumer demands tenderness, especially in beef. If lean meat is tender, most con-

sumers will be well satisfied with its quality. Tenderness, however, can be affected by a number of factors, some of which are inheritance, sex of the animal, age at slaughter, livestock management, including feeding, hanging, or aging after slaughter, and methods of cooking.

With cattle, breed differences in tenderness have not been found to be consistently important. However, large differences in tenderness between offspring of different sires within a breed have been frequently reported. The heritability of tenderness is high (60%) and this indicates that if selection is applied there would be a quite rapid improvement in tenderness. A difficulty here, of course, is to be able to select bulls which leave offspring with tender meat. Special procedures would be necessary and in a sophisticated cattle-breeding enterprise these should be applied.

In general, young and rapidly-growing animals have more tender meat than older animals. Age is more important than sex of animal as a determinant of tenderness, so that the meat from young bulls is acceptable and often indistinguishable from that of steers.

If the interval from slaughter to cooking is long, the meat will be more tender. Using this knowledge, many high-class restaurants overseas age beef for a minimum of 12 days and some for as long as 28 days in order to ensure that the beef will be very tender when cooked. The choice of cooking method appropriate to the cut of beef, the time and temperature of cooking, and the carving and serving are all extremely important factors if the meat is to be tender and acceptable in other ways.

There is no known relationship between the appearance of the live animal and the tenderness of its meat. It should be reiterated that coat type and skin pliability and handling qualities of the flesh in the live animal have never been shown to be important indicators of tenderness or of other palatability factors.

Is Marbling Fat Related to Tenderness?

It has always been believed that the amount of marbling fat within the muscles is indicative of tenderness. Extensive research carried out in the last few years, however, has shown that marbling has only a very small influence on the tenderness of beef from animals up to 30 months of age. Because of this finding, the U.S. Department of Agriculture has recently modified its beef-grading standards so that the

carcasses of young animals no longer need conspicuous amounts of marbling fat to enable them to qualify for the top-quality carcass grades. When assessing marbling in relation to carcass grade, the American beef grader takes into account maturity, that is, evidence of the age of the animal at slaughter. The older, more mature animals (older than 30 months) must have greater amounts of marbling if they are to be placed in the top grades along with the carcasses from younger cattle.

Flavour and Juiciness

The discriminating consumer also wants beef to be flavourful and juicy. Most of the favour of meat is believed to be associated with fat; therefore, in general, the fatter the meat the more flavour it will have. There is, however, a problem in this regard. The modern consumer just does not want more than a slight covering of fat on the meat and consequently the intensity of flavour in the cooked meat may be less than ideal. There are, of course, many millions of people who are quite unaware of how flavourful fully-mature and over-fat beef can be. But there is one thing which is certain. If these persons should ever want beef typical of bygone days they would have to pay dearly for it in terms of price and the amount of waste fat required to be trimmed off at the dinner plate. It may also be tougher than most would prefer. This is the roast beef of "Merry England" never to appear on the tables of the majority.

Colour of Fat and Lean

The colour of both fat and lean has an effect on the shoppers' choice. Firm white fat or light-creamy-coloured fat is preferred as is a fresh, bright, red colour of the lean. The eating qualities of meat with yellowish fat and dark flesh, provided it is from a young steer or heifer, are not noticeably inferior to beef with the preferred colour. It can be said that colour of both fat and lean is a selling attribute rather than a palatability or nutritional factor of importance.

There are no characteristics of the live animal which will provide an index of its flesh and fat colour. However, age, sex, nutrition, management, temperament, and possibly breed are some of the factors known to influence the colour of the lean and fat.

The Challenge of the Future

It is now necessary to relate this information to the live animal and to the beef industry generally. New Zealand's role in the world situation is clearly one of supplying meat for the masses. Admittedly some New Zealand beef is air-freighted overseas and consumed in high-class hotels and restaurants. This beef, however, is comprised of selected cuts which, in any case, amount to only a small percentage of the total carcass weight. These cuts too are not necessarily taken from carcasses of animals regarded as high-quality individuals in the show or stud-breeding sense — they come from carcasses mainly of the G.A.Q. grade although some of this meat may be taken from carcasses of other grades.

The Mass Market

The mass market is a large and ever-expanding one and it requires lean and tender beef which can be retailed at a price that most people can afford. This is the market that New Zealand can and should supply; it will be reliable, expansive and, in terms of quality of the product, it will be more easily satisfied than the very high-class section of the overseas trade. Therefore, satisfy the mass market and the future for beef will undoubtedly be assured.

Description of the Preferred Beast

The animal that will readily supply the needs of the mass market can be described in this way. If the cattle beast is to give a high yield of trimmed cuts when slaughtered it will show a pronounced movement of its muscles as it walks, it will not be "smooth" all over owing to a thick layer of fat under its skin, but it will be wide through the shoulder and hindquarter, will have a small brisket and have a flank which tends to be "tucked up". The twist of the round or buttock will be full and the forearm will be thick, indicating heavy muscling throughout the carcass. In the case of the steer the cod will be small. This preferred red-meat beast will have grown rapidly.

In other words, the beast which will give a high yield of retail cuts is not deep in the body, is not well-rounded in the chest and barrel, is not wide and level in the loin and chine, and does not have a great depth in the crutch. It is not the praised show-type beast; it is the red-meat steer.

Its state of fatness can best be described as half-finished and it will be a young animal with superior muscling giving a dressed carcass of about 550 lb. The cooked beef will be tender, juicy and with enough flavour to satisfy most consumers.

The Impact of Change

The stud cattle breeder must satisfy the requirements of the commercial cattleman and those of the meat market. Without a full appreciation of these two important segments of the industry he could become hopelessly out of date. Changes are coming rapidly and no industry can survive on a static basis. There are strong forces, both natural and artificial, competing with beef for the consumer's money and these forces will be stronger in the future. Certain other protein-producing sectors of agriculture in the advanced countries of the world have been applying science and technology to their total production resources more freely and with greater effect than has the beef industry in New Zealand or elsewhere. The challenge therefore is in the hands of the industry itself. It would be disastrous if the beef industry of New Zealand ignored what one philosopher said: "Some people watch things happen. Some people make things happen. Some people don't know they are happening". If everyone is conscious of the fact that things are happening, then it is possible to influence these happenings in the direction conceived to be most appropriate and beneficial to all concerned.

The round worm burden in pregnant ewes normally rises to a peak some six to eight weeks after lambing. This results in many worm eggs being dropped on to the pasture thus contaminating the feed for the lambs at foot.

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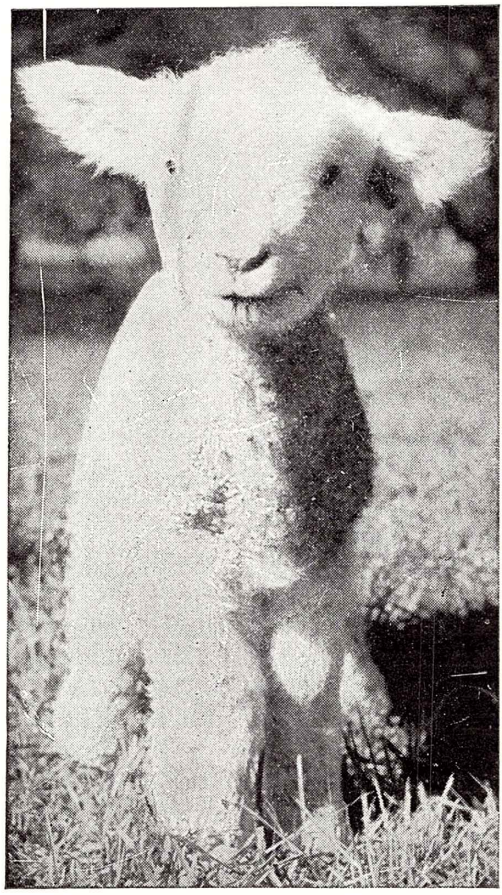

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THE ROLE OF HILL COUNTRY IN FUTURE INCREASES IN PRODUCTION

A. N. TOSSWILL*

SINCE THE WAR, costs and conditions have moved against the hill country. There has been an ever-increasing move towards industrialization, and a draw-off of farm labour towards the advantages now offered in the towns.

Those fortunate enough to have properties suitable for mechanization and the use of some of the new labour-saving techniques have been able to get by and have often improved their production. Others have wondered how long this drain could last and the advent of the Agricultural Development Conference was welcomed on all sides. There are those who now wonder whether its recommendations were indeed bold enough.

Can the farmer be certain if he pushes ahead with development that his debts will not get out of hand? Can he be certain that he will be able to keep the labour to see the development through to completion?

These questions probably affect all farmers in varying degrees, but they will be considered here more particularly as they affect farming in the back areas.

Certain of the incentives suggested in this paper involve some financial assistance to those who are planning development work and before going further it might be wise to anticipate the outcry which may occur in some quarters at any thought of further assistance to farmers as a class. The most vocal critics would be townsfolk who would cite popular ideas of farming prosperity based on tales of soaring land values. They would probably not know that the majority of sales have been confined to one section of the industry, the well-developed easy properties where the areas are generally not large. These are the farms that have had the benefits of increased fertility following mechanization, and, although values have often quadrupled in the years since the war, so also has volume of production.

The demand for good developed farms has exceeded the supply, with the inevitable result that scarcity prices prevail. This pressure on the smaller farms dates back to Land Sales days and has been gradually building up as the advantages of this class of farming under today's conditions become more apparent. Pre-war, this was not so and the

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ambition of the go-ahead farmer centred around a good sized block of hills — such a property as would carry a useful flock without the troubles of horses and cropping then associated with small farms on the easier land.

Government valuations show quite clearly that increases have not been uniformly spread over all classes of land and that values of hill country have lagged behind the easy land. Table 1 gives some typical examples.

TABLE 1: GOVERNMENT VALUATIONS

County	*Date*	*Value (£ million)*	*Date*	*Value (£ million)*	*Approximate Increase During Period*
COUNTIES WHERE HILL COUNTRY PREDOMINATES					
Waikohu	1929	£3.87	1962	£6.70	73% in 33 years
Wairoa	1930	£3.66	1964	£8.65	136% in 34 years
Akitio	1928	£1.48	1962	£2.47	67% in 34 years
Waimarino	1929	£1.60	1962	£3.90	144% in 33 years
COUNTIES WHERE EASIER LAND HAS BEEN DEVELOPED SINCE ADVENT OF MECHANIZATION					
Waipa	1936	£5.50	1962	£31.20	470% in 26 years
Waipawa	1935	£3.02	1961	£14.35	370% in 26 years
Waipukurau	1934	£0.90	1961	£4.50	400% in 27 years
Clutha	1929	£2.90	1963	£19.10	560% in 34 years
Southland	1932	£12.6	1965	£100 (st.)	690% in 33 years

Table 2 shows the movement in sheep numbers in the same counties. If allowance were made also for the extra beef and dairy cattle, the increases on the easier land would probably be more impressive still.

TABLE 2: COMPARISON OF SHEEP NUMBERS

County	*1934*	*1964*	*Approximate Change During Period*
HILL COUNTRY			
Waikohu	652,752	626,000	4% decrease
Wairoa	636,060	786,186	24% increase
Akitio	287,395	337,045	17% increase
Waimarino	299,206	474,252	59% increase
EASY COUNTRY			
Waipa	107,883	376,893	249% increase
Waipawa	440,708	811,858	84% increase
Waipukurau	150,591	252,687	68% increase
Clutha	516,048	1,295,413	151% increase
Southland	1,798,206	4,656,538	159% increase

Unfortunately, the information available on a county basis is inclined to give a slightly distorted picture. There are probably no counties which are wholly composed of hills or easy country and the figures shown are thus of a composite nature. If it were possible to study the history of groups of each class of country, the differences could well be greater. However, the tables show that hill country values and production have not advanced at the same rate as have those for the easier land.

It is understandable that some confusion has crept into the concept of the farmers' wealth, as a result of the highly publicized sales of the relatively small, well-developed properties. On the other hand, sales of hill blocks, apart from inter-family transactions, have been relatively few and prices per acre, particularly for the less developed country, have shown no great movement over the years.

Thus, when deciding what is necessary to assist development of this class of land, its problems must be appreciated and not clouded by ideas of increasing wealth. In many cases the man who owns a large property in the back country faces quite a problem in maintaining existing production and, if this is to be increased, some special type of assistance may be necessary.

Land still Available for Development

There does not appear to have been any comprehensive survey showing what proportion of easy land still requires development, but many would feel that possibly, apart from quite extensive areas in Southland, large-scale development must taper off. Certainly there are still many easy pockets of land, but it seems likely that it may now be necessary to look elsewhere for land with a quick potential.

A survey recently completed by the Soil Bureau, D.S.I.R., provides an interesting breakdown of the contour and potential of the total land area (Table 3).

TABLE 3: CONTOURS SURVEY

	Million Acres
Flat to rolling land with slight to moderate limitations	17.7
Easy to steep hills — moderate deficiencies	17.1
Flat to rolling country with severe limitations — excessive moisture, dryness, pan formation, etc.	3.0
Easy to steep hills — severe limitations	1.7
Unproductive — mountains, lakes, etc.	24.5

The interesting feature of this table is that the total area of the better hill country almost equals the area taken up by the flat to easy rolling category. Since the advent of aerial topdressing, much of the slow deterioration has been arrested and it seems that production could be starting to increase. Is this increase enough to take up the slack as major development work on the easy country tapers off?

Hill Country Development and the Ability of the Farmer to Meet the Extra Costs Involved

There is no accurate information as to the pattern of topdressing on hill country, but it does seem that in normal seasons the progressive farmer topdresses approximately one-third of his total area each year. Many consider that, if the whole farm were topdressed each year, preferably with heavy initial applications plus fencing and oversowing, increases could be quite startling and one of the objects of this paper is to discuss why farmers are not making maximum use of topdressing facilities now available.

The man on easy land would certainly aim to topdress all his farm each year. Why is it so seldom that this would occur on the hills? Many reasons can be given, but the overriding considerations are probably those of finance and labour. Perhaps the thoughts going through the mind of a farmer contemplating such a programme could be summarized along these lines:

(1) Where is the actual cash to come from? In some cases it would be provided by the bank or stock firm as a temporary advance — in others from cash in hand. Whether it be from cash or credit, most farmers are inclined to be cautious, particularly when running up a debt which cannot be met from seasonal income. Perhaps they were fairly heavily indebted at one stage and they do not wish to sacrifice hard-won liquidity at this time in their life. Perhaps they have a fear that, if they run up too much debt for development work, their present living standards may be affected.

(2) What would happen in the event of a prolonged fall in prices. Would the country assist in servicing the increased debt, or would the farmer be left to struggle on as best he could?

(3) Will the extra expenditure increase the value of the farm by a corresponding amount? Particularly in outlying districts there is always some uncertainty as to

the real sale value of a property. Such factors as the total price of the going concern, schooling, and subdivision possibilities often weigh more heavily than actual production figures.

(4) Can additional labour be obtained?

He would, no doubt, consider other factors such as taxation, housing and so on, but the over-riding thought would be the fear of running up debt.

Ploughback Ability

It would be argued that much of the expenditure could be met out of income. Admittedly, if prices remained on the same basis as those of 1964, a great deal more could be done, but, unfortunately, there is no real reason to think that prices for wool will remain consistently at that level. As is readily understandable, farmers have tended to expand and contract their topdressing programme in accordance with the state of their bank balances.

TABLE 4: PLOUGHBACK CAPABILITY — EASY HILL COUNTRY

	1961	*1962*	*1963*
Number of farms in survey	64	73	90
Average area (acres)	974	919	789
Stock carried:			
Sheep	2,498	2,426	2,091
Cattle	241	241	188
Personal drawings	£2,076	£1,590	£1,498
Taxes paid	£1,297	£640	£674
Cash savings available for ploughback	£64	£349	£389
Net farm income	£3,437	£2,579	£2,561

TABLE 5: PLOUGHBACK CAPABILITY — HARD HILL COUNTRY

	1961	*1962*	*1963*
Number of farms in survey	41	44	46
Average area (acres)	2,322	2,206	2,059
Stock carried:			
Sheep	2,753	3,494	3,243
Cattle	501	502	506
Personal drawings	£2,408	£1,775	£1,740
Taxes paid	£876	£592	£455
Cash savings available for ploughback	+£219	—£680	+£1,274
Net farm income	£3,503	£1,687	£3,469

A survey being conducted by the Economic Service of the Meat and Wool Boards has shown that the money available to plough back into further developments in the three seasons of 1961–63 is of quite a minor nature (see Tables 4 and 5).

After meeting living expenses and taxation, there is no substantial amount of cash saving and the survey bears out the fear of many farmers that they would quickly increase their overall indebtedness if they commenced too ambitious a development programme.

Costs Involved

There could be much argument on development methods, amount of manure, subdivision, etc., and it is unlikely that agreement would be reached, as few properties require the same treatment.

The one thing that seems common is the necessity to have a planned programme over a period of years involving initial shock applications of manure, seed if necessary, adequate subdivision, and follow-up topdressings. Table 6 shows the costs per acre over a five-year period.

TABLE 6: DEVELOPMENT COSTS PER ACRE

	£ s. d.	£ s. d.	£ s. d.
1ST YEAR			
2 applications of 5 cwt superphosphate	7 7 0		
Clover seed 3 lb	15 0		
Fencing	6 5 0	14 7 0	
2ND YEAR			
1 application of 5 cwt superphosphate	3 13 6		
Retain 1 hogget	2 10 0	6 3 6	
3RD YEAR			
1 application of 3 cwt superphosphate	2 4 0		
Retain ½ hogget	1 5 0	3 9 0	
4TH YEAR			
2 cwt superphosphate	1 9 6		
Retain ½ hogget	1 5 0	2 14 6	
5TH YEAR			
2 cwt superphosphate	1 9 6		
Retain 1 hogget	2 10 0	3 19 6	30 13 6
Less net revenue from extra sheep			6 0 0
Net cost per acre			£24 13 6

If only one application of 5 cwt were used in the first year, the cost would be reduced by £3 13s. 6d., bringing the net annual outlay to approximately £21 per acre.

No allowance is made for additional housing or the purchase of extra cattle.

The rate of development would, of course, depend on the size of the property, but a minimum of 100 acres per annum would be desirable on the smaller properties with a proportionate increase for larger blocks.

Creation of a Climate Favourable to Development

The figures shown in Table 6 do indicate that improvement programmes on the scale envisaged could not be entirely financed out of revenue and recourse would probably have to be made to loan money. If this is so, some easily understood incentive is necessary to create a climate whereby farmers would be willing to risk increased indebtedness to assist the call for extra production. Taxation concessions are frequently suggested. In the case of very substantial farmers, these could prove a worthwhile inducement, but, if the man with the average size holding commences developing at the pace now asked for, an operational loss is quite likely. His need is for extra working capital for manure and fencing, to allow for the reduction in cash income as revenue stock are held instead of being sold. In accountant's language, the developer is at present trying to undertake capital expenditure out of income and to convert revenue stock into capital stock.

The fertilizer transport concession announced in the budget is of value to hill country farmers, but it is doubtful if it is sufficient to capture the imagination to the extent desired. While the real and fancied fears of lack of finance exist, it is probable that development work will remain spasmodic, being subect to the rise and fall of bank balances. Something more planned is necessary, and it has been suggested that it may be possible to tailor a scheme which would overcome some of the financial difficulties and allow the farmer to plan ahead with more confidence. Catchment boards are able to offer pound for pound assistance towards certain works. More recently, a Farm Forestry Loan Scheme has been introduced. Could not something similar be offered so that planned development work could be financed equally by the farmer and the Government through an interest-free suspensory loan?

This type of approach could create the climate towards the expansion which is needed. But, as Government money

is being used, some supervision would be necessary to see that expenditure was going into the right things.

Perhaps a scheme along these lines would achieve the result being sought:

(1) A district committee to be established comprising, say, three top farmers, and representatives from the Departments of Agriculture and Lands, and from State Advances Corporation.

(2) In conjunction with the farmer, the committee to work out a satisfactory programme of development to be spread over, say, 5 to 7 years.

(3) As the work progressed, the cost to be shared equally by the farmer and the Government through a suspensory loan.

(4) If required, the farmer to be able to borrow his share of the costs from the State Advances Corporation on second mortgage.

(5) In the event of the plan not being carried on, the committee to have the power to ask that the Government contributions should become interest-bearing.

(6) The scheme to be available to all farmers, regardless of what other assets they have.

(7) On the completion of the programme, a procedure to be laid down to see whether the suspensory loan should become interest-bearing or be written off. This could be achieved in two ways:

   (a) By comparison of the carrying capacity of the whole property in ewe equivalents at the beginning and the end of the period.

   (b) By comparison of a special Government valuation of the whole property made at the beginning and the end of the development period.

Of the two methods, the second would have the advantage that it would recognize the farmer's equity before and after the development. If the valuation did not reflect the expenditure on development, there could be a good reason for writing off the whole or part of the suspensory loan.

The examples given in Table 7 illustrate the principles which could be followed where £3,000 p.a. had been spent on development over a period of five years.

TABLE 7: EXAMPLES OF APPLICATION OF DEVELOPMENT SCHEME

Government value of property *after* development	£60,000	£50,000	£40,000
Value *before* development	30,000	30,000	30,000
Appreciation in value	30,000	20,000	10,000
½ share in total costs of £3,000 p.a. borne by farmer	7,500	7,500	7,500
Capital gain if suspensory loan written off	22,500	12,500	2,500
Capital gain if suspensory loan becomes interest-bearing	15,000	5,000	—5,000

In the case of the £40,000 property, the suspensory loan would have to be wrtiten off. This could be the position which may occur if farming had run into a prolonged period of low prices or where very high development costs were encountered. On the other hand, the £60,000 property has shown a worthwhile capital appreciation, and, even if the full amount of £7,500 in the suspensory account became interest-bearing, the farmer would still have a capital appreciation of £15,000 and could not justify asking that this amount be remitted. Some compromise action could be made for the £50,000 property.

In practice, it is probable that there would be few cases where any writing off would be necessary as inflation plus extra production could boost values to a stage where it would clearly be shown that the farmer's equity was substantially greater than formerly.

It could be said that such a scheme would involve the Government in too high an outlay. The rate of development would, however, be limited to the ability of the farmer to breed sufficient stock for the new areas. Unlike the man on easy country, he cannot normally buy the extra stock necessary and must rely on his own flock to provide replacements and this factor would clearly govern acreage which could be handled.

There seems no reason why some variation of this scheme could not be applied to the easier country which has still to be developed.

Labour

Since the step up in industrialization, the biggest worry of the back country man is the thought that his staff may

walk out in the middle of lambing or during some other critical period.

The subject of labour has been discussed at great length and it is obvious that the social problems are such that it is unlikely that there will ever be a complete solution. However, the one fact which does stand out is that the farmer who is twenty miles from town has a greater problem in retaining staff than his counterpart only five miles away. Apart from the obvious fact that the employee who is close to town can enjoy the advantages of semi-suburban living, there are two other aspects which can weigh heavily against those who are further out:

(a) *Transport*: Most employees wish to come to town at least once each week, and a round trip of, say, 50 miles over rough roads plays a heavy toll on the cars, particularly the older models which many must run. If no school bus is available, an additional 100 miles per week could often be added. The cost of maintaining vehicles to do this work is a heavy burden on a shepherd earning even £20 per week.

(b) *Schooling*: Where a school bus is not available, the shepherd whose children are reaching school age has the alternatives of correspondence or transporting them daily to the nearest school. Both of these involve the womenfolk to a degree not known in the towns.

If the development of the back country is to get off the ground, there must be some incentive available to farm labour also. In spite of town attractions, there is undoubtedly a stalwart body of men who like this life, but they cannot be expected to carry on if they are suffering financially and their children are not having a fair chance of education.

The Production Council could well give thought to some scheme which would overcome the present unsatisfactory position. Consideration could be along these lines:

(a) *Transport*: A mileage allowance on a graduated scale to be payable from Government sources direct to the employee.

(b) *Schooling*: Where it is impracticable to extend the bus service to outlying districts, free boarding facilities be provided for children.

The bursaries at present available are not sufficient to enable the working men to take advantage of them, particularly when there are several children.

Summary

(1) The easy country which has had the full advantage of mechanization since the war has probably been responsible for a large proportion of the increase in stock numbers during this period.

(2) The quick potential of the arable land is running out, and if the rate of increase is to be maintained the hill country must take up the slack.

(3) The spectacular increases in land values have been largely confined to arable land — there have been relatively few sales of hill country farms.

(4) The high prices for small, well-developed farms have had a great deal of publicity. This has tended to give the impression that all farmers are doing very well and are quite able to find money for improvement without outside help.

(5) Development of hill country by topdressing and oversowing is costly and, when compared with regrassing through ploughing, rather inefficient.

(6) It is evident that the ability of the hill-country farmer to improve his property out of income is limited. To achieve the rate of increase now asked for would imply a considerable rise in indebtedness.

(7) There are indications that, although most farmers still have borrowing powers, they are loth to increase debts without some assurance that they will receive assistance if prices fall.

(8) Much thought has been given to incentives, but, to date, efforts have concentrated on providing some blanket system which would apply to all farmers. The needs of a hill farmer who has a major development scheme on his hands are rather different from those on an established dairy or export lamb farm.

(9) Some easily understood scheme seems necessary to establish a climate whereby those who have properties with unused potential will feel that the incentive is "too good to miss".

(10) A suspensory loan scheme, providing a £1 for £1 assistance for approved work, would go a long way towards establishing the climate required. The inclusion of a provision for review on the completion of all or part of the work would protect the farmer in the event of the value of the property not increasing suffi-

ciently to cover the debt. It would also protect the taxpayer should the property rise in value owing to extra production, inflation, or a combination of both.

(11) A properly administered scheme would ensure that development work was seen through to completion, thus avoiding the "stop-start" methods based on cash available.

(12) The cost to the Government could be considerable, but approved schemes would necessarily be limited to the ability of the hill country farmer to breed the extra stock.

(13) It is probable that the scope for this type of development on the easier land would not be great.

(14) A criticism could be that land values would be forced up in anticipation of Government help. This could indeed occur, but it would be a foolish man who purchased a property at high values and then did not take advantage of the scheme.

(15) Because of high motor transport costs and difficulties for schooling, some incentive may be necessary to encourage staff to remain in the back country. The aim should be to create conditions whereby the shepherd is no worse off financially than his counterpart closer in.

Conclusion

The targets set by the Agricultural Development Conference envisaged an annual increase from the sheep industry of approximately 4%. The figures for the first two years have not increased to this extent and it does seem that, if the objective is to be met, more must come from the hills.

If these farmers are to be able to develop their land at the pace now required, they may need some financial assistance to reach the new level of production. Likewise, the staff who will run these properties will need some help if they are to have a way of life similar to their counterparts closer to town.

The hills can provide the extra stock units, but the way must be clear for the farmer to go ahead with his planned development knowing that it will not be hindered by the twin worries of labour and finance. Furthermore, if positive action is not taken, there is a chance that production from the lighter and more isolated country will taper off and in some cases be lost permanently.

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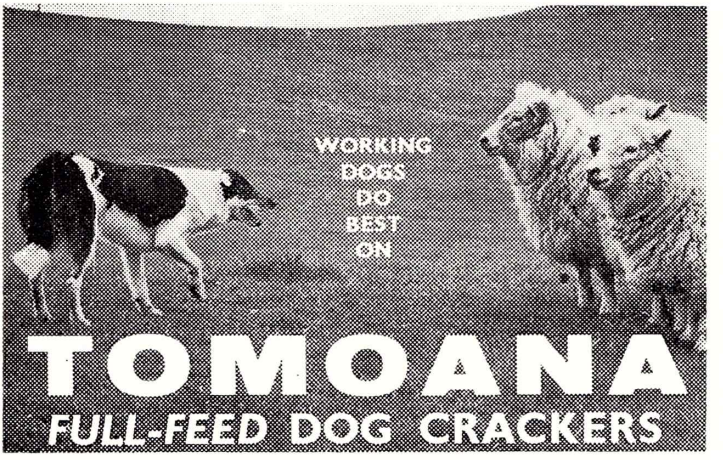

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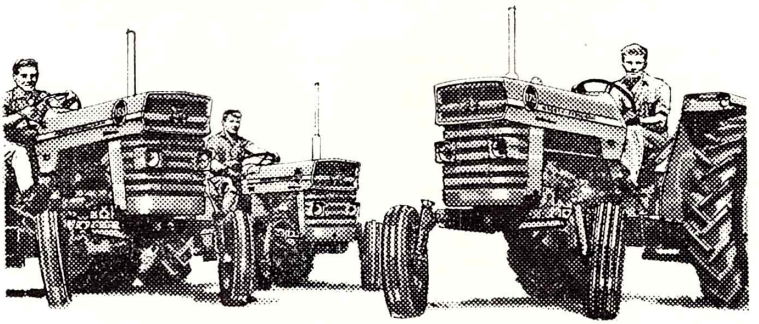

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HIGHER LIVING STANDARDS THROUGH INCREASED LIVESTOCK NUMBERS

H. G. LANG*

IN his opening paragraph of the 1965 Budget, the Minister of Finance said: "One of the Government's major aims is to bring about a rising standard of living for the people of New Zealand. This objective will require . . . more systematic planning than we have been accustomed to in the past. . . . "

If it is accepted that rising living standards are desirable, there must be a clear understanding of what is meant by more systematic planning. This is the first point which will be discussed in this paper. There are five other points that will also be examined:

(1) Why an increase in livestock is necessary for higher living standards.

(2) How the national livestock target of 111 million ewe equivalents by 1972–3 was established.

(3) The sort of capital investment needed to achieve the targets.

(4) Incentives for high investment.

(5) The machinery which has been established to supervise the whole operation.

What is Meant by Planning

Planning does not mean having a national plan which is carried out by the use of direct controls and regulations covering all aspects of economic life. The kind of planning under discussion in New Zealand is the consultative or indicative type used in France and a number of other western economies. The essence of indicative planning is consultation with the people affected. Unless they help formulate the plans and intend to do their best to carry them out, then such planning comes pretty close to "whistling in the dark". Another essential aspect of indicative planning is the setting of targets. Agriculture in New Zealand is well suited to realistic target-setting. Statistics for New Zealand agriculture are among the best in the world. The producer boards, the Federated Farmers organ-

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ization and the Government departments concerned have a great deal of information about, and contact with, the farming industries. The machinery which has been used for the setting and supervising of agricultural targets will be discussed later.

Why an Increase in Livestock is Necessary for Higher Living Standards

Apart from land and a good climate, New Zealand has very limited natural resources. This means that, if secondary industries are to continue to develop, increasing imports are needed of raw materials and other equipment which cannot be made in New Zealand. Many consumer goods which, for various reasons, cannot be produced here, are also required. A rapidly rising export income is therefore essential. It is a fact of economic life that, even by the end of this decade, over 90% of export income will still be coming from livestock production.

This is not to say that a large increase in non-agricultural exports has not been allowed for. Indeed, the targets assume a much faster growth of exports from other products — forest products, apples and pears, frozen peas and seeds, and manufactured foods — than from wool, meat, dairy products and their by-products. The targets also assume a very large increase — a 250% rise in 10 years — in receipts from tourism and travel.

How the Targets were Established

The Targets Committee of the Agricultural Development Conference, which did most of the work on the targets, made a number of important assumptions:

(1) A 4% cumulative growth of gross national product. Allowing for an increase in population of about 2% a year, this means an increase in the real standard of living of the people of 2% a year.

(2) An average price for wool throughout the decade of about 42d. per lb, average prices for meat of £150 per ton, and dairy prices approximating those operative at the time (at that stage the guaranteed price for butterfat was 32d. per lb).

(3) Constant terms of trade.

On the basis of these major assumptions, the Committee worked out the total export income which will be required in 1972–3 to finance the import of raw materials and consumer goods which an expanding economy with a rising population will require. Having done this, an estimate was made of how much can reasonably be expected from increased exports of other than pastoral products. The remainder can obviously come only from higher pastoral exports. The results of these estimates are given in Table 1.

TABLE 1: PROJECTED VALUE OF EXPORTS NEEDED TO BALANCE OVERSEAS PAYMENTS

	£ million		
	1962–3 Actual	*1972–3*	*Increase*
Pastoral exports	282	422	140
"Other" exports	21	45	24
Total exports needed	303	467	164

The increased income required from pastoral exports was then converted into increases in livestock numbers. For this purpose, the Conference used a mythical animal, which is not yet bred to perfection, called the "ewe equivalent"; but this concept of the "ewe equivalent" is useful for planning purposes. The conclusion was that 111 million ewe equivalents are required by 1972–3. This means an increase in livestock numbers each year of 3½%. Such figures may not be very meaningful to individual farmers. Perhaps the target can be roughly expressed in simpler terms. Leaving aside the question of additional farms, the achievement of the target depends on the man who wintered, say, 1,000 ewes in 1962–3 wintering 1,500 ewes in 1972–3. That is an average, and averages can be deceptive. But it gives a fair idea of the increase which the individual farmer would need to achieve if living standards are to be raised at a reasonable rate.

Capital Investment Needed to Achieve the Targets

No one is under the illusion that the mere setting of a national livestock target will produce more animals. A major effort is needed; but in the view of the Conference, this is an effort which is within the country's capacity. Over the decade, there needs to be a repetition of the rate of

livestock increase achieved between the mid-1950s and the early 1960s.

It takes time to breed extra animals. In the last year or two, the rate of growth of sheep numbers has been disappointing; but a tremendous amount has been done in heavier fertilizer application, land clearance, subdivision and fencing. Estimates which have come to hand recently indicate that the number of sheep and cattle wintered this year is substantially higher than in the last two years, and close to the rate required if the targets are to be achieved.

It takes about £4 of investment to secure an annual increase in production of £1. Therefore, the targets will require something of the order of £500 million worth of investment in capital application of fertilizer, in land clearance and sowing, in buildings, tractors and houses, and so on, over the decade. The major contribution which the Government has made to supplying investment funds may be indicated briefly. The rural lending by the State Advances Corporation four years ago was about £7 million. In the financial year ended March 1965, over £20 million was authorized for such loans.

Two years ago, the amount voted by Parliament for the Marginal Lands Board was £350,000. Following recommendations of the Finance Working Party of the Conference, and of the Conference itself, the vote has been substantially increased, and for the current year £1,250,000 has been provided. This is a remarkable rate of growth in any terms.

Incentives for High Investment

The most important incentive to increased farm investment is, of course, provided by favourable export prices. The extent to which Government can provide general incentives, if export prices are unsatisfactory, is severely limited by financial considerations. It is obvious, for example, that the Government could not compensate woolgrowers for the fall amounting to some £25 million in this year's wool prices. The Government, however, can provide, and in fact has provided, major specific incentives. For example, the right of farmers to deduct practically all development expenditure for tax purposes is a major concession not available to any other sector of the community. The newly introduced fertilizer subsidy should also assist those who are developing farms which are distant from fertilizer works.

The Machinery for Target Setting and Supervision

Before the Agricultural Development Conference was established, the Targets Committee, set up by the Ministers of Finance and Agriculture, had worked out livestock targets on the basis explained earlier. Represented on the Committee were Federated Farmers, the Meat, Wool and Dairy Boards, the Meat and Wool Boards' Economic Service, the Department of Agriculture and Treasury. After the target had been adopted by the Conference and endorsed by Government, the Targets Committee was reconstituted as a major Conference committee with the same membership, and called the Production Committee.

Three important policy decisions arose out of the Production Committee's work.

The first is the establishment of a permanent industry-Government body, called the Agricultural Production Council, which is chaired by the Minister of Agriculture, with membership embracing the chairmen of the three producer boards, the President of Federated Farmers, the Department of Agriculture, and Treasury. The terms of reference of the Agricultural Production Council are "to keep under review the livestock target of 111 million ewe equivalents and propose changes if necessary; to propose measures considered necessary to the attainment of the targets, and consider matters referred to it; to publicize the targets and the facilities and concessions available to farmers to increase production; and to consider the implications of the targets for ancillary industries such as fertilizer manufacture and cool storage".

It was obvious that a central Council could not, without some district organization, hope to deal with the large task of keeping in touch with what was going on in various parts of New Zealand. There is a major job to do in keeping farmers informed of the objectives implied in the targets, of the finance available and of the facilities offering by way of taxation incentives, etc. Existing machinery, *e.g.*, Federated Farmers, dairy companies, the extension services of the boards and the Department of Agriculture can cope with a substantial proportion of the work. However, the second result of the Production Committee's work has been the establishment of a number of district committees on an experimental basis. These committees have proved successful, and it is now intended to establish district committees throughout the country. These committees, apart from providing a flow of information out to farmers and

back to the centre, should help to isolate any local factors which are limiting production in particular districts, and also assist farmers in meeting individual problems with finance, and so on.

The third question arising out of the Production Committee's work was whether and in what way the national livestock targets could or should be broken down into districts. Much work has already been done by the Department of Agriculture on this matter, and the whole problem was discussed fully at a recent meeting of a working party set up by the Agricultural Production Council. The Council is likely to consider this problem at its next meeting.

Conclusion

It is almost a platitude that, for the decade ahead and beyond, increases in New Zealand's real standard of living will depend largely on increased exports of pastoral products. This requires substantial increases in livestock numbers. To assist in achieving these, New Zealand has embarked, for the first time, on a form of indicative planning, the essence of which is the setting of targets by consultation between Government and farmers' representatives, and creation through a process of democratic discussion and decision of a climate favourable to the attainment of the targets. As far as the Government is concerned, policies must be adopted which will ensure that sufficient resources of finance, manpower and materials are available, and that incentives are adequate. The increased production, however, can come only from the farmers. While the methods used can always be criticized, and while mistakes will inevitably be made, there is little doubt that living standards will be raised through increased livestock numbers.

Acknowledgement

The writer is indebted to W. A. E. Green of the Treasury for assistance in the preparation of this paper.

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CAPITAL FOR FARM DEVELOPMENT

A. R. Low*

THE increased livestock numbers required during the next eight years and beyond might be relatively easy to achieve if there were plenty of unoccupied land awaiting settlement, but such land is scarce now. It might be easy if there were a supply of additional labour awaiting employment on the land; but it obviously does not exist. For New Zealand as a whole, and for farming in particular, both land and labour are, and will continue to be, scarce commodities. The required increased production must come mainly from existing farms, as a result of two fundamentally important factors, more intelligent farming, and more capital. It is with the second of these, capital for farm development, with which this paper is concerned, but the first is far from being irrelevant because capital also is relatively scarce and must be used in the most productive way. It is too easy to waste capital.

It is not possible to say exactly what it costs a farmer to increase his carrying capacity. The figure is different for each farm, but it has been estimated at between £8 and £15 per ewe equivalent, with an average of, say, £10. When this figure is multiplied by the several million additional ewe equivalents required, it is obvious that a lot of money must be spent on farm development as a matter of high national priority. The exact amount cannot be calculated. The important thing is not to argue about the figures but to ensure that farmers *want* the money because they *want* the development; then it is the responsibility of the financial institutions and other lenders to provide the money, on reasonable terms, to credit-worthy borrowers who can use it effectively.

Existing sources of capital for farming are extensive, generally adequate, and capable of growth to meet the hoped-for demand. A high proportion of the money for farm development now comes out of the farmer's own net income, after he has paid tax and his family's living expenses. Unfortunately, this residual amount varies greatly from year to year, and may at times be a negative quantity. By contrast, if a farmer is to undertake the task of developing his property, he is likely to need funds regularly over several years to match the programme of work. Since reinvestment of income is a major source of farm capital, a pruning of vital expenditure when farm income falls will

* Deputy Governor, Reserve Bank, Wellington.

sooner or later bring about a decline in the rate of growth of farm production. Continuity of supply of capital is important, and should, if possible, be reasonably assured before the development programme is started. Lending institutions have been urged to watch this aspect, because borrowed capital plays a part, and often a predominant part, in farm development.

Finance for an effective development programme has four component parts:

(1) A willing, even a keen, borrower;

(2) A willing lender;

(3) Reasonable loan terms;

(4) A credit-worthy borrower who can use money effectively.

These will be considered in turn.

The Keen Borrower

People will incur debt only when they feel it is worth while, financially and in other ways. One of the objectives of the Agricultural Development Conference and now of the Production Council is to persuade farmers that spending money (borrowed if necessary) for increasing livestock numbers is highly worth while in the national interest, and also profitable from the farmer's own point of view. It means higher net income (not necessarily immediately), a larger capital asset, a worthier estate to pass on to his heirs (death duties notwithstanding), and a boost to his self-respect. If all this happens to be in accord with the national welfare (and it is), how much more willing should a farmer be to get the best out of his land, even if it means borrowing. Farmers, in general, have plenty of equity against which to borrow.

The Willing Lender

There is no lack of institutions from which to borrow. There is not, and should not be in the future, any great difficulty in the provision of seasonal finance for farming. Credit for this purpose is normally available from stock and station agents, trading banks, and to a lesser extent from dairy companies. Even in times when there is a credit squeeze, banks are asked to give highest priority to produc-

tion of goods for export; though this does not mean that farmers are exempt from restraint and can get all the bank credit they would like.

A good deal of minor development work is financed within the normal seasonal arrangements. Often development work is undertaken without any specific repayment arrangements being made. The result may be a "hard core" of nominally short term debt, which is unsatisfactory to both borrower and lender. Refinancing of this hard core by means of long-term mortgage is probably appropriate, especially if further borrowing for farm development is wanted.

It should be made clear that a more specific consideration of loans for farm development does not include mortgage loans for the purchase of a property. In practice, there may be some money for development included in such mortgages; also, in many cases, a change of ownership is a prerequisite to the improvement of a property. However, the concern here is with loans to farmers specifically for development purposes. There are three main sources of this capital — the State Advances Corporation, the Marginal Lands Board, and the term loans of the trading banks.

The policies and activities of the State Advances Corporation and the Marginal Lands Board should by now be well enough known among farmers, but this is not always true. In the last two or three years in particular, the Corporation has increased its rural lending both in amount and as a proportion of its total lending; and of its rural lending an increasing proportion is directly or indirectly for farm development. It has a lot of experience now, and has adapted its methods and lending terms to meet the circumstances of the borrowers. It has the great advantage of having trained field staff who can help the farmer to work out his programme of expenditure on development. The same applies to the Marginal Lands Board. Here are two specialized and skilled institutions whose job includes lending to farmers who want loans for development. In 1964–5, the State Advances Corporation authorized rural loans amounting to £21 million, twice the figure of two years previously. The Marginal Lands Board in 1964–5 authorized loans of £1,120,000, nearly double the previous year's total. These funds have to be provided by the Government, that, is by the people of New Zealand.

The system of term loans made by the trading banks is only two years old and is perhaps not very well known yet. The amount available is still small (£2.9 million) and its

use is not limited to farming. It is for any form of worthwhile productive project. A term loan is for a medium term of 5 to 7 years, with repayments by regular instalments. So far, about £½ million has been lent to farmers and farm contractors under this scheme. The amount available for term loans might some day be increased, and any farmer wanting money for a development programme would do well to inquire about term loans from his banker as well as visiting State Advances Corporation and Marginal Lands Board.

Loan Terms

A borrower is seldom satisfied with the terms on which he has to borrow. This is human nature; everyone would like to borrow very cheaply (if at all) and repay in a leisurely manner. But it must be remembered that the lenders are not charitable institutions (even the Government lenders); the funds they lend have cost them money; they have administrative expenses to meet; and they may have (*e.g.*, insurance companies, banks, savings banks, etc.) many thousands of customers who have lodged money with them and expect it to be kept safe and available. The Government might lower its already very favourable lending rates, but this would amount to a subsidy which, on top of the other concessions to farmers, many people would not think justified. In any case, the Finance Working Party of the Agricultural Development Conference found that "a low interest rate is not in itself a major incentive and that other inducements are likely to be more successful in encouraging farm development". A well-conceived programme of farm development should produce such a growth in net income over a period that the rate of interest on the borrowed money — unless well above the present range of rates — is a fairly minor consideration. There are examples of actual figures to confirm this.

Credit-worthy Borrowers

Not every borrower is able to get the money he wants and thinks he deserves, and the blame is readily placed on the lenders. But, as already mentioned, lenders are not charitable institutions. They are experienced at the job, their funds are not unlimited, and there are alternative uses for those funds. In short, the borrower must be credit-worthy in the eyes of the lender, and the purpose of the

loan must pass a number of tests too. So a loan is not likely to be forthcoming unless:

(1) The farmer is a good farmer, reliable and hard-working.

(2) He can provide security for the loan.

(3) His fixed commitments are not so high already that the servicing of a new loan would create too much of a burden.

(4) The loan money is to be used wisely in a properly-thought-out programme of development, from both a technical and financial point of view.

The personal factor is always important. So also is the deevlopment plan. Good money can be wasted in farming as well as elsewhere. The importance of using the advisory services which are available in respect of both farm management and accounting cannot be emphasized too strongly. There is plenty of technical knowledge available that is not being used.

It is not possible to describe fully all aspects of finance for farm development, but the main points made may be re-emphasized:

(1) Farm development is a national necessity.

(2) Funds are likely to be available to credit-worthy farmers who have a well-planned programme of development for their property.

(3) Such programmes are likely to be sufficiently profitable for the farmer to give him a strong incentive to borrow for the purpose.

The need, the means, the technical knowledge, the incentives are all there. All that is needed is the people to take the initiative -- the farmers.

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FARM MANPOWER

N. S. Woods*

This paper discusses briefly the findings of the Manpower Working Party of the Agricultural Development Conference. The first task of the Working Party was to solicit facts. Some very serious deficiencies were found. The only year-by-year statistics of the number of persons in farming are the estimates prepared by the Department of Labour which have to be based on the five-yearly census information of the Department of Statistics. While practically every other industry in this country has labour force information collected at six-monthly intervals, farming has it collected only once in every five years. Moreover, the five-yearly information collected in 1961 did not become available from the Department of Statistics for another three years. Consequently, the estimates of farm labour force which the Department of Labour was making in 1963 were still being based on the 1956 Census and were well out of date. Thus, the very first recommendation which was brought down was for annual collections of statistics of farm manpower.

Some of the other facts which the Working Party was able to establish will now be considered.

In 1962, there were 3,395 boys and 220 girls who, as they left school, indicated farming as their work interest. Some 13% of New Zealand's labour force is in farming, but some 17% of school leavers were looking towards farming. There were plenty of young people interested in farming, and if they did not actually end up in farming, farmers will have to ask themselves the reason why. These young school leavers with an interest in farming are sufficient in numbers to give all the farm labour force farming can use — if farmers can clinch their interest and hold them in the industry.

Farming has also done reasonably well from immigration. In the 10 years, 1951–61, farming occupations had a net gain of 6,407 from immigration. Over those 10 years, with something of the order of 30,000 school leavers plus upwards of 6,000 immigrants looking towards farming, it has to be conceded that farming has had ample opportunity to recruit all the labour it needs. Why, then, is it short of labour?

The age-structure of the farm labour force suggests that, while the industry fails to get possibly a quarter of the school leavers who indicate an interest in farming, it nevertheless does reasonably well in recruitment. In 1961, it had

* Acting Secretary, Department of Labour, Wellington.

22,700 people under 25 years of age, and it had retained all except a few hundred of the 23,943 people who had been in the industry and were under 25 years of age in 1951. But at about 35 years of age, an exodus begins and between 1951 and 1961 some 12,000 people between the ages of 35 and 65 left the industry. This appears to be the real problem. There is plenty of water going into the bucket, but there is a big hole in the bottom of it. The important thing is not to cry out for more water (which is what the industry has been doing) but to plug the hole.

The Farm Manpower Working Party therefore had a close look at some of the things which might contribute to this exodus of experienced men in mid-career. Some factual information was secured on farm wages. First, the various Extension Orders were considered. These were found to be unattractive documents compared with the general run of awards and industrial agreements. The adult rates are at about the level of rates for unskilled labour and the Orders give no recognition for skill and responsibility above the minimum. In other industries, these things are formally recognized and the award or industrial agreement provides a scale of rates related to the degree of skill, experience, or responsibility. Extension Orders are dumb on such matters. They hold out no promise and give no guarantee of anything better than a minimum unskilled wage. The farm worker is entirely dependent upon the beneficence of his employer as to whether he gets anything better. Some do and some do not, but good quality men with a due sense of responsibility for their futures and their families do not accept a nebulous prospect.

Of course, many farmers are in fact paying actual rates far above the minimum rates in the Extension Orders, but the average rates being paid are not so high. In a sample of 438 sheep farms, married men were, on average, receiving £3 17s. 3d. above the minimum award and single men £3 7s. 9d. These are *averages*, which means that while many farm workers were receiving more than this, just as many were receiving less. At the time of this survey, the average wage of a married man with house provided but no rations was £13 18s. (*i.e.*, on the farms covered in the sample).

The Department of Labour's ruling rate survey of February, 1964, showed that a carpenter was then receiving, on average, £16 13s. 5d. for the first 40 hours worked during the week. At that time, the average amount of overtime worked in the building industry was 5½ hours. Thus, it can be estimated that, on average, a carpenter was then receiving at least £20 for a working week of 45½ hours.

The Working Party appreciated that farmers' incomes are governed largely by export prices and that the farmer cannot pass on increased costs. The Working Party also appreciated that in individual cases farmers were in fact paying £20 a week or more to experienced farm workers and finding it worth while to do so. Bearing these factors in mind, the Working Party was convinced that several things needed doing regarding farm wage rates.

First, farmers should get rid of the cloak of secrecy round the actual rates being paid. In many cases, these are rates fully capable of attracting a good type of worker if they are made known. For example, a farmer who approaches the local Department of Labour office for labour wants a good man who can handle a tractor. When asked what he is offering he names the minimum rate, but "something more for a good man". He will not say how much more. The Labour office knows of a good tractor driver who might be interested and puts this vacancy to him. The driver immediately wants to know the wage offered. The vagueness of the offer kills his interest. He takes a job with a local authority at about £17 a week. When the farmer hears about this he says "but I would have paid him £18 a week". If he had said £18 a week at the start he would have got his man.

Secondly, the fringe benefits could be publicized with advantage. Free firewood, milk, meat, opportunity to own some livestock, and so on, are valuable additions to income but they will not attract people to farming unless people know about them.

Thirdly, the Extension Orders should be reconstructed to provide certain rates above the minimum rates for certain classes of workers, *e.g.*, for workers who have completed a recognized course of training; for workers with special competence in the handling and maintenance of farm machinery; for in-charge positions such as head shepherds. This would not necessarily cost farmers anything extra because they are in fact already paying the higher rates to such people.

Other factors were found which possibly cause people to leave farming. The Working Party was told of farmers (not too many, though) who give the farm worker the uninteresting and hard work and keep the more interesting work for themselves. Naturally the farm worker (unless he is a dispirited no-hoper) will not put up with such a situation for very long. It was told also of farm workers who left farms when their children began to reach high school age because they wanted to live within reach of a school. The Working Party has expressed the thought that at least a proportion

of such people could be saved to the farming industry if there was some organized means of putting them in touch with vacancies on farms near post-primary schools. Information was supplied on how school bus services affect farm labour. how farm workers' wives may suffer from boredom, how transport services or car ownership might reduce problems of isolation; how the need to start buying a house in preparation for retirement may induce farm workers to move into the town in middle life. There are many of these social factors which could be inducing people to move out of farming and the Working Party recommended that there should be a small permanent staff engaged in studying such problems and seeking solutions.

An endeavour was made also to establish the facts regarding shortage of farm labour. Here, more difficulty was experienced. It would no doubt be difficult to find a farmer who did not genuinely feel that, at least at certain times of the year, he would like more assistance than he actually gets. It is obvious also that many farmers and the members of their families are working long hours. This does not mean, however, that all these farmers are able and willing to engage and pay for full-time, permanent farm workers.

From the material available to it, the Working Party was satisfied that there was a current shortage of some 200 to 250 experienced shepherds and that this was the most serious shortage of *permanent* farm labour. Apart from shepherds, there was a continuing demand for permanent farm labour, but while this was greater in some districts than in others, it could not be fairly described as a serious general shortage of permanent employees.

A shortage of seasonal or casual labour, particularly at certain times of the year, was more evident and poses quite a difficult problem. As stated in the Working Party's report, "the days when such calls for labour could be adequately met from a pool of more or less permanently unemployed or under-employed men are long past".

Three solutions to this problem seemed apparent, none of them being in any sense a complete solution. The expansion of agricultural contracting enterprises was one possible remedy. Group labour schemes also offered a remedy in suitable circumstances. In the past, some such schemes have succeeded and others have failed and it is only common sense that in future the pattern of the successful schemes should be followed. Another solution was the increased use of labour-saving machinery, coupled with the development of farms of an appropriate size, to enable full

use to be made of both full-time labour and labour-saving techniques. In general, farming must increasingly learn to live without casual and temporary labour in a world where full employment is an international as well as a national objective.

All over the world there has been a decline in the ratio of farm labour force to farm output as farm techniques and machines have improved, and rising farm incomes have enabled farmers to take advantage of these things. New Zealand is no exception. In 1952, the farm labour force was 129,000 and farm output was in the ratio of 482 ewe equivalents to each member of the farm labour force. In 1962, the farm labour force had reduced to 121,000 but farm output had increased very substantially and was in the ratio of 658 ewe equivalents to each member of the farm labour force. The Targets Committee of the Agricultural Development Conference estimated that by 1972 farm output should reach a level of 111 million ewe equivalents. If output per member of the farm labour force continued to increase at the same rate as between 1952 and 1962 (when it increased from 482 to 658 ewe equivalents), it would reach 904 ewe equivalents in 1972 and on this basis a total farm labour force of some 122,800 would be needed.

This is, of course, very rough reckoning, but it is sufficient assurance that, to meet such a target, no really large increase in farm labour force is required. But these figures heavily underline that the farm labour force must be one of steadily and rapidly increasing efficiency. By 1972, each member will, on average, have to be about twice as efficient as in 1952.

For this reason, the Working Party on Farm Manpower considered that its most important recommendations were those dealing with the training of farm workers. The following extract is from the Working Party's report:

> Training of farm workers is important for many reasons. The existence of recognised training encourages the recruitment of a type of young person interested to learn and seeking a lasting vocation rather than a job. Properly organised training, moreover, widens the usefulness of an employee and brings him to full competence more rapidly. The well-trained farm employee, like the well-trained farmer, will give better care to livestock and crops, will maintain and use machinery more effectively, will cope better with emergency situations, and will avoid losses and contribute to better production. Moreover, an employee who has won a recognised status as a skilled man in any occupation is less likely to leave that occupation. The Working Party therefore gives considerable weight to the importance of training as a factor in increasing farm production.

The Working Party considered that there should be a unified national training scheme. These are the main features of the national scheme recommended by the Working Party: There would be a National Farm Training Council representative of Federated Farmers, Young Farmers Clubs, the Departments of Agriculture and Education, the agricultural universities and any substantial organization of farm workers. Associated with this Council would be a full-time Commissioner of Farm Training to run the administration of the scheme.

In any district where it was decided to operate the scheme, an Advisory District Committee on Farm Training would be set up on much the same representational basis as the National Council. Associated with the Committee there would be a full-time District Supervisor of Farm Training to carry out the local administration of the scheme.

The National Council would be the policy-making body, deciding such matters as types of training, length of training, conditions of traineeship, and so on. The District Committees would be responsible generally for applying such policy in the district, but more particularly for approving farms as suitable for training, approving changes in training, transfers of trainees, terminations of training contracts, and certifying completion of training to a satisfactory standard.

The District Supervisor would be the main point of contact between school leavers and approved farms and would arrange the contracts of training, maintain follow-up contact with the trainees, keep the necessary records, attend to inquiries, and keep the District Committee informed on progress of trainees and report any problems to it.

Training would be for three years. It would be mainly on-the-job training with the trainee working for the farmer for wages and changing from one farm to another to get experience. There would be a certificate issued on completion of training to the satisfaction of the District Committee. There would be no examination but trainees would, in appropriate cases, be encouraged to sit examinations or take university training.

It is a simple training scheme. The Working Party thinks it is an intensely practical one which will be easily workable. Farming is a skilled and complex industry with many special problems. Among the many things the Working Party suggested could help the industry to secure a labour force adequate to its needs, training, without a doubt, is the most important.

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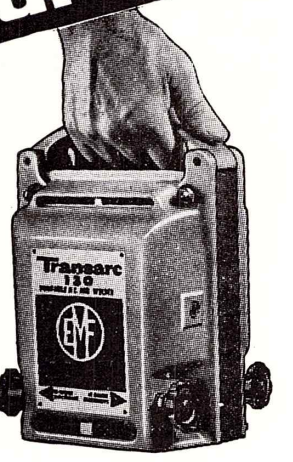

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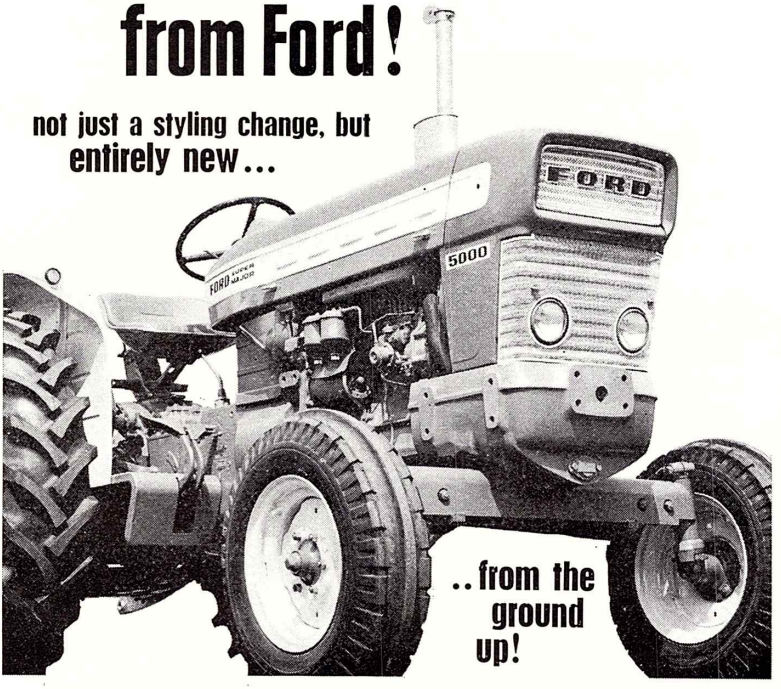

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TAXATION INCENTIVES

J. D. FRASER*

TODAY, all that a farmer spends on development is deductible for taxation. If he wishes, the deductions can be spread equally or unequally over any one or more of the five succeeding years.

Typical items of expenditure which are fully deductible for taxation are construction of fences, irrigation, clearing land of timber, scrub, undergrowth, etc., prevention of erosion, forming of air strips, and eradication of vermin and pests.

The Government has recently extended this provision, and all development expenditure is now fully deductible up to the end of March, 1967.

Standard Values for Stock

A farmer may adopt, and most do adopt, a standard value for his stock so that increases in stock can be written down from market value to standard value, thus deferring the tax liability on the difference. In most businesses where stock is carried, the Inland Revenue Department requires that it be valued at the lowest of three alternatives, cost price, market value, or replacement cost. However, for farmers an additional option is available — the standard value system for livestock.

The effect of the standard value basis is that, where a farmer adopts a standard value of 30s. per head and purchases sheep at £3 per head, he is able at the end of the year to obtain a deduction for income tax purposes of the difference between the purchase price of £3 and the standard value of 30s. While a farmer continues in his occupation, his tax liability is therefore deferred, but problems arise when he sells out, or wishes to hand his stock on to his family, or if he dies. Various provisions have been written into the tax laws to give some relief from these situations.

Where a farmer gifts livestock to a child, stepchild or grandchild who is over 18 years of age, he may hand on the livestock at standard values provided these are not unduly low. In this way, the deferred liability may be passed on to the next generation and, in turn, to a further generation.

* General Manager, N.Z. Wool Board, Wellington.

There is also a provision for trustees of farmers' estates to continue farming at the standard values which had been adopted by the deceased.

The farmer who wishes to retire and sell his property faces a rather special difficulty. If he does not transfer his stock to a child or grandchild, but sells farm and stock to a stranger, he has previously been permitted to apportion the extra profit made from the sale of his livestock over the year of sale and the *preceding* three years. In this way, some relief was afforded but in most cases the assessable income was quite substantial in the three years prior to sale and high taxation was still paid.

Quite early in the work of the Agricultural Development Conference, it was recommended to the Government that some further provision be made for such a case. Accordingly, tax legislation in 1964 made it possible for a farmer to spread the profits made from the sale of his livestock over the three years *succeeding* the year of sale. This meant that a farmer, on retiring, could have three options; he could spread the profit which he made in the year of sale over the three years before he sold, or assess the profit in the year he sold, or assess the profit over the three years following sale.

Farmers everywhere welcomed this recognition by the Government of a particular problem, and the enaction of this legislation should encourage farmers who are becoming elderly to sell their farms to younger men.

Fertilizer Concession

A fertilizer concession exists at the moment. For 1964 and 1965, a farmer can deduct at the rate of 150% for taxation purposes the cost — that is, the spread cost — of increases in fertilizer over and above a five-year average usage.

Although there have been anomalies in the use of this concession, it was in general well used and was a most timely incentive to farmers to increase their usage of fertilizer. However, it has been recognized that the continuation of this 150% concession for increases must be of diminishing value to farmers because, as they progressively use a five-year average to fix their base on which to gauge increases, these increases will become less. For this reason, the Development Conference did not recommend that the 150% deduction be continued unless the Government found it was not able to bring into effect the recommendation of the Farm Costs Working Party of the Conference which

stated that a transport subsidy on fertilizer would be preferable to a tax incentive. These proposals have now come forward in the 1965 Budget and farmers have welcomed them.

Depreciation Allowances

Several depreciation allowances are applicable for farmers. There is the investment allowance of 10% for plant and machinery which allows a farmer to write off 110% of the cost of an asset during its useful life. On the west coast of the South Island, there is a special provision whereby the investment allowance is at the rate of 20%.

Special depreciation on plant and machinery is a further concession which enables the farmer to write off 20% of the cost of plant and machinery in the first four or five years after purchase.

Initial depreciation applies to farm buildings. Up to last year, a farmer could claim depreciation of 20% of the cost of certain buildings on the farm, such as employees' cottages and shearers' quarters. The Development Conference recommended to Government in 1964 that this provision be extended to cover all farm buildings with the exception of the owner's homestead. The Government accepted this recommendation in 1964 and farmers may now also claim depreciation on farm buildings such as woolsheds and barns. These depreciation allowances are in addition to the ordinary depreciation applicable to every asset.

Income Equalization Reserve Scheme

An income equalization reserve scheme was recommended by the Development Conference at the end of last year and has since been accepted by the Government, to apply for the year ending March 31, 1965. As this scheme is new to farmers, it will be dealt with here in more detail.

The basis of the scheme is that a farmer shall be permitted to create a reserve of up to 25% of his assessable farm income in any given year. A minimum of £100 is imposed in respect of individual deposits.

The time that payment can be made is most important. A farmer may make a deposit during the year in which he earns the income, or he may make it up to one month after the time for putting in his tax return, or within six months after balance date, whichever is the earliest. This is a most important provision, for it enables the farmer to know how

he has progressed during the year in respect of which he wishes to make a deposit, and he also has some idea as to how he is faring in the following year.

There is a provision which will be incorporated in the legislation that a deposit may not be made in respect of any given year if a voluntary withdrawal has been made. This provision is designed to ensure that the scheme is not merely used as a means of building up deductions for tax purposes and thereby becoming an arrangement for holding working balances.

No interest will be paid on deposits. This is in line with the position regarding the two wool retention schemes which operated in 1951 and 1964, and it is also the case with snow loss reserve deposits.

Refunds may be taken out with the same provisions as to time as apply for deposits. There will normally be a minimum period of twelve months for deposits, but in case of hardship this provision can be dispensed with by the Commissioner of Taxes. All deposits will require to be refunded within five years from the end of the year in respect of which the deposit is made. If, however, in any given year a withdrawal has to be made because of the five-year provision, then in that same year a deposit will be allowed. This deposit will, of course, be 25% of the farmer's total assessable income from that year, which will include the compulsory refund.

The keynote of this scheme is that it will need to be used intelligently by the farmer. It is easy to criticize the scheme and say that a farmer who does not make a planned use of it does not avoid paying much income tax. The whole idea of the system is to allow farmers to plan development which might otherwise be difficult because of fluctuating income. Demand for goods and services created by high farm incomes, such as happens in the year of a high wool price, should be avoided and the farmer enabled to plan his expenditure. The greatest advantage which can be gained by the farmer is, of course, if he works out his farm operations to ensure that refunds which he takes from this income equalization reserve account are spent on deductible items, such as repairs and maintenance or development. In this way, he can gain a very real advantage. Again, the farmer will be helped if the country receives a greater measure of stability in its economy. Many inflationary pressures come on farmers' costs because of large expenditures during years of high prices. Higher costs for farmers never seem to come down when overseas prices are falling.

Some of the provisions at present in force, including some recent alterations, have been discussed. It is now proposed to consider some of the recommendations of the Agricultural Development Conference which have been made to the Government but which so far have not been accepted by it, or at least have not been put into effect.

Land Tax

Most will agree that land tax should be abolished. Just over £1 million is collected as land tax but, because it is deductible for taxation, the costs of abolition are probably not more than £500,000 when costs of collection are taken into account.

Meat and Wool Levies

The Conference has recommended that meat and wool levies should have special concessions in taxation. These levies are already deductible for taxation in the ordinary way but they are expressly prohibited from enjoying the special provisions for promotion and development expenses of manufactured goods and tourism. Today, all market development expenses and promotion expenses for exports other than meat and wool and dairy produce enjoy a 150% tax deduction. The Conference recommended that a tax rebate of 5s. 0d. in the £1 for all meat and wool levies should be put into effect immediately. The Conference felt that such action by the Government would be recognition of the work being done to increase the price levels of primary exports.

Estate Duties

The Development Conference also recommended a reduction in the scale of estate duties which have long been recognized as a disincentive to farm development.

A strong recommendation was included for an exemption for all adult children. At present an exemption of £500 exists for each child under 21 years but a child older than 21 years does not receive any exemptions in the parents' estate. The recommendation for exemption for all children is £2,000 per person with increases as soon as possible to £5,000 per person.

The recommendations on estate duties are in two tiers and some examples of the effect of the first tier will be of interest:

(1) Estate duty on an estate of £20,000 left equally to two children would be reduced by one-third.

(2) Estate duty on an estate of £30,000 left as one-third to the widow and two-thirds equally to three children would be reduced by 56%.

(3) Estate duty on an estate of £45,000 left as one-third to the widow and two-thirds equally to three children would be reduced by 40%

It is considered that the first stage of the recommendations should be enacted as soon as possible and then serious consideration should be given to the bringing in of legislation to encompass the second stage.

Maximum Rate of Income Tax

There are two proposals of which little mention has been made in recent times. The first is the level at which maximum rates of income tax apply and the steep graduated scale of tax. The Conference urged immediate study of this problem for it strikes at the heart of the drive for increased production. This recommendation was, in fact, made the first one in priority of the Conference. It is recognized that the maximum rate of 13s. 6d. in the £1 is reached at £3,600, while the maximum rate in 1938–9 was not reached until the figure of £7,900. Exemptions at this time are greater than those obtaining in 1938–9 but there is no question that the value of money in 1965 is a great deal different from that of 1938–9. The raising of the maximum at which the top rate applies could be expensive to Government revenue for it would encompass all taxpayers throughout New Zealand, but it is felt that this move should be made in the interests of increased effort by all workers in New Zealand.

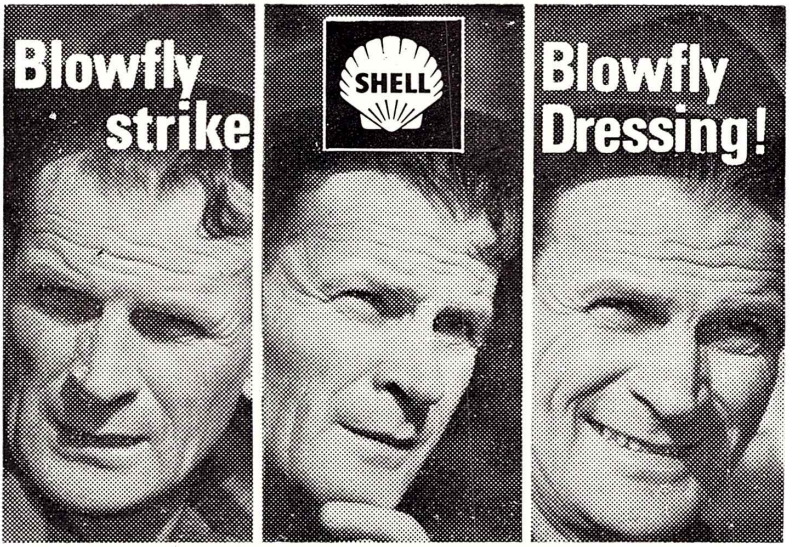
Livestock Increase Incentives

Second, there is the question of a direct incentive for increases of livestock which the Development Conference examined very carefully and which has since received much attention from the Agricultural Production Council. Several schemes have come forward. Some of them are able to be administered but are not good enough as an incentive, while others are sufficiently dramatic as an incentive but are full of loopholes and most difficult to administer. Two schemes which had much merit involved the payment of a cash benefit to the owner of livestock for every head of increase in livestock which he attained. These schemes have failed

mainly because the farmers' books of account are not kept universally on a sufficiently high standard. The schemes themselves were desirable but there were so many opportunities for farmers to gain more benefits than they were entitled to receive that it was not possible to recommend the acceptance of the proposals by the Government.

Finally, particular reference might be made to the standard of accounts which are kept for farmers. Many farmers pay a fee to their accountants which demands that the books are properly kept and ensures that all information which the farmer should have is rendered to him. This would include full reconciliations for all classes of stock for the year concerned. Farming is big business today but unfortunately a large number of owners of property do not consider that their business warrants the standard of accounting which, in fact, it demands.

The research group of the New Zealand Society of Accountants is at present examining an acceptable form of standard accounts for farmers. When these accounts are produced, it is hoped that farmers and their accountants will accept them readily. The writer believes the Inland Revenue Department should insist that farmers use the standard form of accounts if certain concessions in taxation are to be gained. These may appear to be strong words, but a viable incentive for livestock increases would probably have been proposed to Government before now if all farmers had been using a sound form of accounting.



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VACUUM SILAGE FOR BEEF CATTLE AND SHEEP

J. L. DOUTRE*

AT the 1963 Dairy Farmers' Conference of Massey University, in the "What's New" session, the subject of vacuum-packed silage was first presented, and dealt with the initial work from small 2 and 3 ton heaps built in 1959, and later work on the larger 90 and 500 ton stacks built in 1961 and 1962. Some of the difficulties of sealing were described, and the development of field techniques to make airtight silage possible. The most important feature of this research was the complete elimination of waste — a problem which has plagued workers in fodder conservation for the past 125 years, since early work in England showed that this could be partially achieved by heavy compaction. The complete removal of air by consolidation was resorted to with variable success.

Most of the benefits derived from airtight silage systems have been understood by farmers for many years, but the building of expensive tower silos and the costly equipment necessary to fill them and feed out from them have prevented their wide application in New Zealand. Their high initial cost is difficult to accept when their small size and the inflexibility in operation are considered; they do not allow for changes in yearly enterprise, the ensiling of extra crops in good years, or the cut-back in overhead costs during poor market conditions.

Now, with the use of light and relatively cheap polythene, or PVC sheeting, the operation is completely simplified; small or large quantities of crop can be made into silage as desired, to cope with the seasonal growth; any surplus can be fitted into the feeding programme, or stock-piled as security against future shortages. There is not the need to purchase expensive blower or unloading equipment, and, when a breakdown does occur, it is far easier to repair or exchange only the tractor or harvesting equipment than to deal with specialized machinery. Work-stoppage seldom holds up progress of the operation. It is also quite possible to work with one or several units on the same stack, and there is no set pace dictated by the speed or bottle-neck of expensive machines.

During the past two years, this simple method for vacuum compression of silage has been used to form above-ground

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stacks, the usual double-ended wedges, or ramp stacks, and even for filling lined concrete bunkers. It has become an accepted practice and over 1,000 such stacks have been built and evacuated, encompassing almost 200,000 tons of grass, maize, and other fodder crops. The subject no longer qualifies for a "What's New" session; the practice has been tried and proved, first by town milk suppliers and the dairy industry, and now it has spread into the feeding of beef and sheep. It has even been used for race-horses and sows.

The vacuum silage method has certain advantages over all other systems. It is less expensive than the interest on the capital invested in the airtight structures which cost several thousand pounds per 200 ton capacity. Being versatile in siting, feeding, and able to be of any desirable size, it can be built when and wherever desired to cope with any feed surplus available.

(1) With complete air evacuation, cellular respiration of the plants ceases, and they suffocate, thereby ending the cause of heating in silage. Food nutrients and sugars are not consumed, the proteins and vitamins are not cooked out, so nearly all the value of the original plant is retained in the vacuum-packed plastic container.

(2) Since there is practically no rise in temperature, the silage never reaches the warm conditions favourable to the putrefactive and destructive bacterial types, which would compete strongly against the desirable lactic bacilli. The colder conditions favour the production of lactic acid and a high concentration is soon built up to destroy other bacterial types. These anaerobic

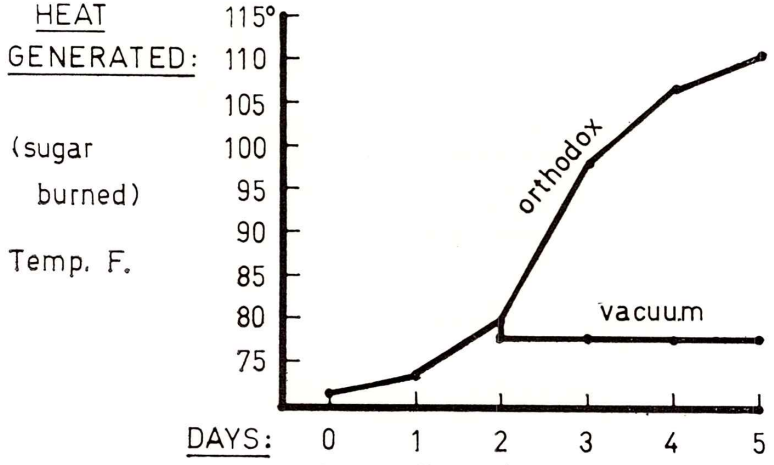

FIG. 1: *Rise of temperature is controlled under vacuum, and respiration and oxidization cease almost immediately.*

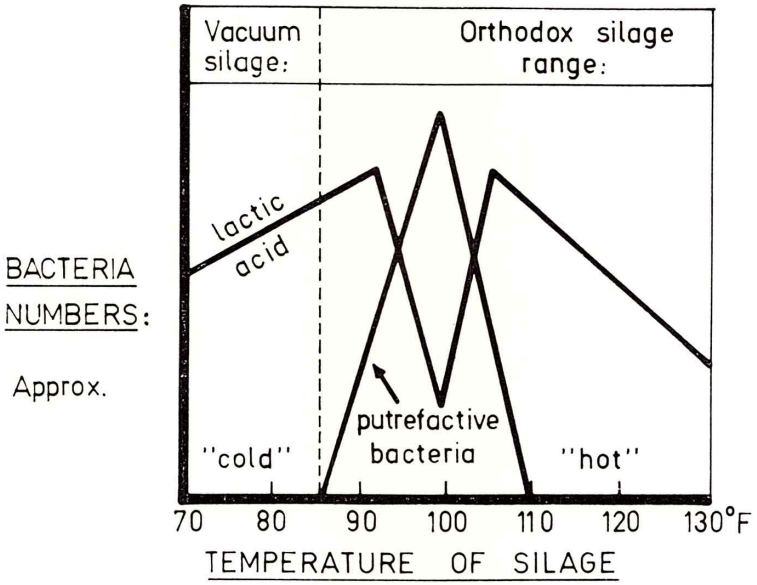

FIG. 2: *The most desirable range for cold silage is a feature of the vacuum silage process, and the maximum production of lactic acid.*

bacilli work in the absence of air and require far less sugar and other food nutrients under these conditions.

(3) With the exclusion of air, there is no initial or continuous slow burning, or oxidation normal to other silage systems. Little carbon dioxide is formed, or effluent expressed as run-off of food nutrients.

(4) Vacuum silage usually has a fruity odour, so the stack can be situated near buildings, feeding yards, or the race system — centrally placed for good access and utilization, without the worry of smell. Few flies are attracted as there is no place for them to enter and lay their eggs. Biting flies are not a problem, if they are locked out and cannot breed.

(5) The compaction of well-rolled silage is about 30 lb/cu. ft. By the use of vacuum compression, the volume is immediately halved, allowing twice as much to be put into the space, without waiting for settlement. The solid mass, usually reaching the weight of water, or 62 lb/5 cu. ft, is much safer to work over, yet it can be opened free of slime or mould, and added to again and again until no further material can be enclosed within the cover.

(6) The final compacted height of the stack is easily judged, for self-feeding, or feeding out with machinery. Low stacks for sheep would otherwise be far too wasteful due to top wastage through exposure to the weather. Although mechanical feeding may be far more efficient of ensiled material, self-feeding will reduce labour to a minimum.

(7) Seldom is silage superior to the original grass or fodder from which it is made, but the product is much more uniform in quality, and is available exactly when required. It is free of mould, fungal growth, or rot which makes the stack unpalatable. This highly desired vacuum silage is relished by livestock, and little is wasted in the feeding process. There is never the problem of filling mangers, or feeding racks and then having to empty them out again. Successful feeding depends on quality.

(8) Saving both feed and money is the most important aspect of all, by the use of the plastic envelope, to conserve feed through periods of plenty. By direct cutting and careful harvesting, little grass is lost in the paddock. There are no leaves shattered or lost in picking it up; practically all that is cut goes into the trailer or truck. Little dead material is left on which spores can form to cause facial eczema.

The constant removal of toppings from paddocks keeps them clean from weeds and trash, and is a vital part of good pasture management. This food should be conserved as a maintenance ration during periods of shortage.

There is no better method of feed conservation than the properly evacuated stack, which has been sealed and well covered. The main enemies of polythene sheeting or PVC are wind, hot sun, and little boys. A good fence would exclude livestock and dogs. Baits might be laid for mice or crickets, if the crop is to be carried over until the following season, during a year of surplus feed. A sheltered corner under trees is advisable.

Cows will eat from 80 to 120 lb daily, when given free access to it, and a dairy cow can produce up to 2.8 gal of milk from full rations. Similarly, beef cattle can make liveweight gains of 2.5 to nearly 3 lb daily under ideal growing conditions. Feed quality must be high if the stock are to be maintained in a forward condition throughout their growth period, without a check in growth. They should be fully fleshed at finish, but not in an over-fat condition. Vacuum

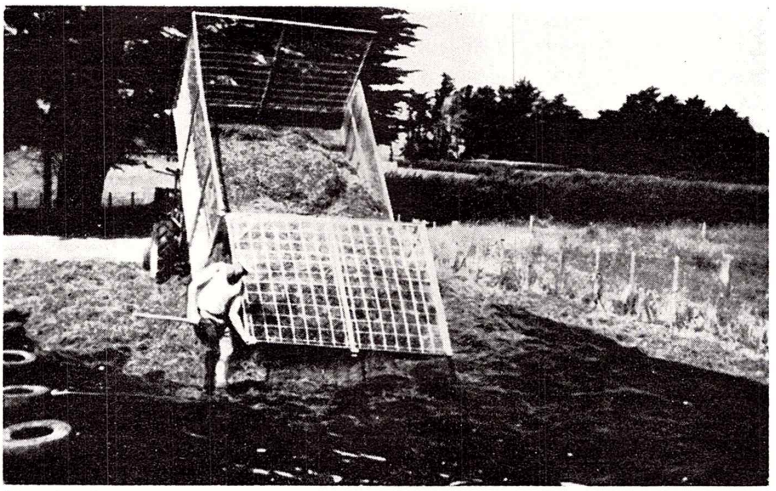

FIG. 3: *Careful covering of the ground sheet in preparation to build a double-ended wedge for vacuum compression.*

silage has also been used to produce baby-beef from calves 2½ to 3 months old, fed for 6 to 7 months through the winter on small plots, at about 8 to the acre. Dairy heifers were similarly reared. Some sheep and beef farmers will be geared for haymaking or may find that there are silage harvesting problems due to a lack of local contractors or equipment; but in most cases, just as they now depend on the haymaking contractor to bale in December or January, it will be just as easy to harvest a better crop of silage six weeks earlier, and extend the season with additional cuts of either hay or silage later. The usual slump in clover growth due to late cutting for hay crops is not a problem associated with the making of silage, since smothering of clover growth is not so marked. The crop is not so stemmy, and is of much higher feed quality. Field losses are much lower, since no wilting or rain losses are experienced. The chances of getting a good crop are over 80% of the entire silage season, October to May, as compared with only 40% of the much shorter haying season, December to February.

Should the farmer choose to purchase his own harvesting machinery, as many sheep and beef farmers are doing, this equipment can be used for a greater variety of work on the farm. Grass can be ensiled throughout the season; during the last spring to autumn growth season, silage was harvested from October until May, some of this being stockpiled to carry forward into next year.

Although grass surpluses usually occur later on the sheep farm, such late crops of lush material would generally make poor conventional silage. By means of the vacuum process this material is more readily made into a highly palatable product. Autumn-saved pasture cannot always be adequately grazed at the desired height, owing to seasonal growth conditions, and, when it bursts away, there is little else to do than to harvest it for silage in good autumn weather — at a time when it would be almost impossible to make hay.

Silage harvesting proceeds as long as the grass is dry; the weather can be taken as it comes. When the first drops of rain begin to fall, the cover is quickly drawn over the heap, whether it is 2 or 10 ft high, and sealing of the stack can proceed in the rain. Evacuation is no problem, and the silage remains intact until the weather changes and the sward is dry enough to commence again. All the crop cut is under cover immediately. This presents a very different picture from the making of hay.

Although the stack can be made any desired size, the larger ones are much more economical of plastic used — it pays to think big! There were a number of stacks of 50 tons, and a few of 800 tons, made last season. The cost varied inversely from 11s. per ton down to only 2s. 6d. per ton, with the average being near 5s. The savings in foodstuffs more than amply repaid the extra cost of evacuation, because waste is also inversely related to the size of the stack.

While dealing with the various costs of crop conservation, the cost figures for harvesting contractors who make both hay and silage show that the average 300 ton stack of vacuum silage compares more than favourably with the equivalent acreage or dry matter content of baled hay. Compare hay cutting, raking, baling and storage in the barn, with the entire process of harvesting, and ensiling within the plastic cover, sealing and evacuation, allowed about 11 bales of hay per ton of silage, 3,300 bales to 300 tons: the contract costs are usually less than two-thirds the cost of making hay. In fact, the price of polythene to cover the larger stacks of silage per ton is almost as cheap as the twine to encompass the bales.

The self-feeding of silage to beef would appear to be more desirable than its use for dairy cows. This depends on high quality materials, and the animals eating everything put before them. A well-designed feed barrier, hurdle, or tombstone type feeder will reduce silage wasted at the

FIG. 4: *Stack being completed for second evacuation by vacuum process.*

open face to a minimum. The splashing of slush forward on to the base of the silage face is prevented by shielding the lower 20 in. of the barrier. Some barriers are designed to be moved by the farm tractor, and pushed into the face with runners sliding on the concrete floor under the silage. This prevents their tipping back, and they can be moved forward by the cattle to within 18 in. of the face. Others are designed so the cattle stand on the front and cannot move it; these are pinched forward by the farmer, and can be lined up straight along the face. Any silage left should be pitched on to a trailer and carted to a dry site where it will be consumed by more timid stock. The barrier openings should be vertical slots about 1 ft wide, and up to 5 ft in height. The tombstone units are usually 9 in. timber, having 9 in. openings between. All units should be designed for easy fitting on to the tractor three-point linkage, and not wider than the narrowest gate they will be driven through.

The overseas trend toward low moisture silage in the past three years has been prompted by the need for greater mechanization in silage handling. Fine chopping of silage has similarly assisted with the consolidation and reduced clogging in auger machinery. Both these aspects have made it easier for livestock to eat and obtain a higher dry matter intake. Less acidity is required to ensile grass, owing to the

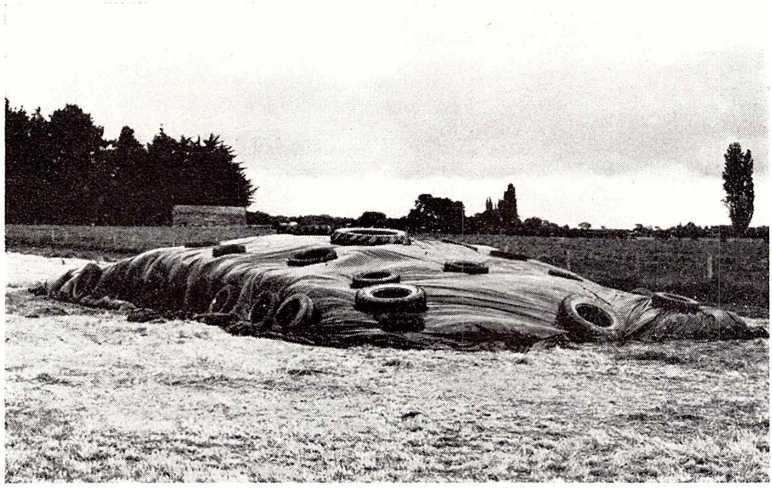

FIG. 5: *A low stack suitable for feeding to sheep during facial eczema periods or at other critical times.*

greater concentration of sugars in the cells of the plant. But it must be considered essential to use airtight storage for success with the new product, often termed haylage.

Less moisture has to be carted to the silo, making for lighter loads; there is little effluent, or the associated smell of rotting material; the food produced is more palatable to stock, not soggy, nor acid. But, with all these refinements, there is a price to pay.

The wilting of silage demands double handling and the weather and the ground beneath the sward must be dry and conducive to rapid drying. Field losses are considerably higher if the wilting process takes more than a few hours. Unfortunately, complete figures of the high field losses associated with wilting, and the comparative costs of double handling have not been worked out, but under wet land conditions during harvest wilting is prolonged, and periods of drying would be much longer than is experienced in lower humidity areas where this practice is usually advocated.

Some wilting of legume crops such as lucerne is desirable, to reduce dilution of available sugars and the incidence of butyric acid formation in the crop. The product is best ensiled under completely airtight conditions, such as a sealed tower silo, or, of course, the vacuum silage system.

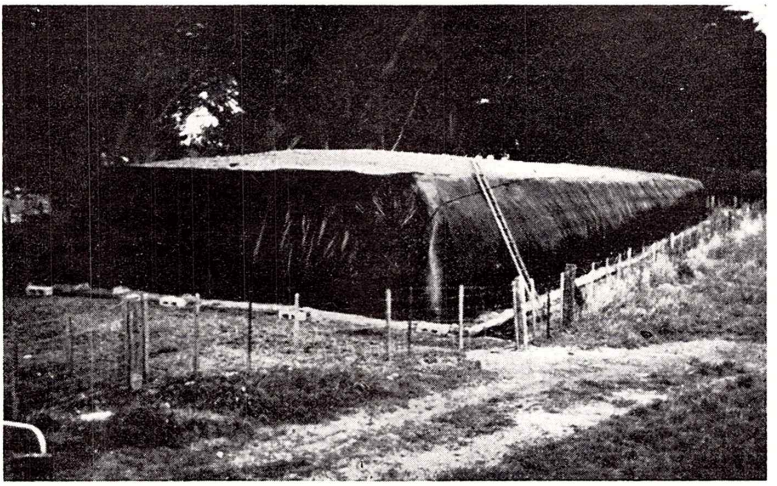

FIG. 6: *A well-built 800-ton stack. A front-end loader can be used to deliver the silage to a stock-feeding system of troughs or racks.*

It may not be advisable to wilt much below 65 to 70% of moisture or heating can recommence when the silage is opened up to be fed out. The fodder need not be finely chopped to consolidate it with vacuum, as it is quite possible to vacuum compress even buckraked material by this process; but, of course, longer material must be cut out of the stack, making it much more difficult to remove feed with the front-end loader or hand fork.

The use of vacuum silage opens an entirely new field to sheep feeding. During drought or facial eczema periods, they can be held as a mob around a low stack of vacuum silage and they can be adequately fed until the condition is over. The cover might even be resealed again if care has been exercised to protect it during feeding out.

Future developments of this feeding system would, of course, be toward increasing beef numbers, and feeding them better, thereby producing more top-grade beef on land now producing stores. Much of the gamble is removed from this enterprise on the drier areas subject to drought, if a stock-pile of silage is available to see the herd over any dry period. The annual fluctuations in stock numbers could be evened out, increasing the carrying capacity of entire districts to a higher productive potential. Farms having

a reasonable area of flat land, in conjunction with hill country, could contour electric fence their steep country for better control of spring growth by grazing. They could then harvest the limited flat areas toward select sites. Self-feeding of silage could replace hay in some instances in the development of rough country, while full-feeding the herd to a better standard. Where fertility is in good balance, and up to a high standard, nitrogenous fertilizers have been used economically to produce a bulk of feed from limited acreages. This demands soil testing and generous applications of phosphate, potash and lime. Growth has been shown to carry through beyond the first cut of silage into the succeeding pasture with good results, and with no slumping of clovers.

If beef fattening farms are to be pushed further into the hills, and produce more carcasses or packaged beef for the world market, it must be done by more adequate feeding. There is little doubt that the fastest means of doing this is by carrying all surplus crops forward to periods of shortage. In a sense this entails more crop utilization, the harvesting of more grass throughout the growing season, to fill in all the shortages. It will entail a more continuous supply of beef to the works, over a longer period of the year, to fill the demands more evenly. This, too, can only be achieved by full-feeding during the winter months and drought periods. A steer's summer growth is a reflection of his winter condition, and feed availability. Under this policy, the writer envisages greater beef production and a higher number of cattle on sheep farms, particularly when sheep numbers exceed 1,200 to 1,500 per holding.

On fattening farms, the trend has been toward larger numbers of dry stock held for shorter periods throughout the late summer, autumn and winter months.

A REVIEW OF HAYMAKING METHODS AND EQUIPMENT

M. W. Cross*

Theoretically, the conservation of grass in the form of hay is a straightforward proposition. First, grow a desirable species or combination of species, and grow it well. Then let it reach the desirable stage of maturity, cut it, reduce the moisture content to a safe level quickly, and store it until required for use.

Translating theory into practice, without losing quality and quantity, is a different proposition altogether. Of the methods employed to do this, it is almost true to say "there's nothing new under the sun", because most methods have been tried before, at some time or another. Hay has been made for a very long time and the difficulty of drying and retaining quality has long been appreciated. The first reference in literature to artificial drying using forced air and supplemental heat was in 1869 — nearly 100 years ago.

The main advances in the last 20 years have been technological. New machinery has been produced which enables established principles to be implemented with greater precision and rapidity. The majority of current research involving the use of new equipment confirms many of the well-established principles which formerly were difficult to employ on a large scale because of the lack of suitable mechanical aids.

Reduction of Moisture Content

Grass cut for hay has a moisture content of between 77% and 84% (wet basis) depending on variety, climate, time of day, dew, etc. It is living when cut and the normal vital processes are still active until the moisture content has been reduced to 35% to 40%. Until this stage has been reached dry matter loss will occur, and the longer drying takes — whether in sunshine or shade — the greater will be its loss. From this point to the stage where it can be safely baled (below, say, 25%) is the most difficult for moisture extraction.

Although no further dry matter loss occurs, nutritive losses will become significant the longer the hay is exposed. Should drying conditions deteriorate, or rain occur, these losses may be substantial.

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Basically, then, there is need for haste in drying — to keep both dry matter loss and nutritive loss to a minimum.

Artificial drying fits into this pattern very neatly. In its most economic form, artificial drying is used to extract only the last of the moisture from the crop. Full advantage should be taken of natural drying conditions and field treatments to reduce the moisture content to round 35% to 40%. This can be done in one to one-and-one-half days, so the weather risk is virtually eliminated. When this hay is baled, clover or lucerne leaves are still tough and firmly attached to the stems so no cracking or fragmentation occurs as is the case when field-dried crops are baled. When these bales are later fed out the absence of dust and fragments, with their subsequent loss on the ground or in the wind, is most noticeable. This feature alone must have a considerable influence on the reduction of nutrient losses, since lucerne, for example, when cut at the correct stage consists of about 57% leaves.

Hay cannot afford to be a highly-priced commodity or it will be ousted by other forms of conservation or supplementary cropping. If it is to be used as a production ration, it can carry the increased cost of artificial drying (round 30s. per ton) but for general maintenance purposes the logical approach is to improve field curing methods to reduce losses and still end up with hay at an acceptable cost.

Field Curing

The rate of drying in the field is influenced by three factors:

(1) The temperature.

(2) The humidity of the drying medium.

(3) The rate at which the surrounding air is removed with its load of evaporated moisture. To promote rapid drying, and keep losses to a minimum, it is essential, then, to aid these three factors as much as is possible.

Trials as early as 1915 established that there is virtually no difference in nutritive value between fresh grass and vacuum-dried grass — the ideal method of drying. So, the nearer the ideal can be approached, the higher the quality of the conserved product.

Although overall control of climatic conditions during field curing is not possible, weather reports and knowledge of local climatic conditions can be invaluable in selecting the time to cut. From then on the greatest use should be made of what is offering. If a swath is left as it falls from the mower, and wilting commences, moisture will begin evaporating. On the surface of the swath the heat will be greatest, the evaporation rate high, and the moisture-laden air can move away freely, thus aiding rapid drying. Underneath, evaporation causes a drop in temperature, so drying is slowed. The moisture-laden air cannot move away freely, humidity rises, and drying is further slowed. Moisture from the soil increases the humidity of this air under the swath and so wilting or drying of the lower portions of the crop is virtually stopped. The only time when the lower sections will dry at a reasonable rate is in the presence of a strong wind.

Another fact which must be mentioned at this stage is that leaves dry more rapidly than stems. Clover and lucerne leaves do not break off until the leaf-stalks are approximately 30% moisture content, nor do they shatter till reduced to round 16% moisture content. The main cause of leaf loss due to mechanical treatment is both the lack of uniform drying of the swath as a whole, and the slower drying rate of the stems compared with the leaves.

Surely, then, this interpretation of the drying process indicates the correct treatment to give the freshly mown hay to make the most of prevailing drying condiions.

If cut with a conventional mower, the first step would be to turn the crop upside down into a loose swath to allow air to percolate easily, to shield the leaves and expose the stems to the better drying conditions on the surface. Doing nothing more than this reduces drying time by one-third, compared with leaving the swath unturned. Further reductions in drying time can be achieved by turning the hay at frequent intervals (say two-hourly, or less) to maintain a relatively uniform temperature throughout the swath, keep it in a loose swath to facilitate air percolation, and shift it from place to place to minimize the effects of soil moisture. Crushing or cracking the stems of legumes and bruising or lacerating the grasses has proved to speed drying but the operation must be done at cutting or immediately afterwards to be of maximum value. Hay will stand vigorous treatment during the first three-quarters of the drying period with negligible losses — provided that portions of the swath are not allowed to become over-dry.

Mechanical Aids

Nowadays, numerous mechanical aids, which were not available to farmers of earlier years, permit the implementation of these recommendations. The type of equipment to be used will vary with the circumstances of individual farms. For correct utilization it is essential first to understand the purpose of each piece of equipment and then use it in a manner calculated to achieve that purpose. Many criticisms of equipment arise through inattention to this detail. Operating instructions, settings and adjustments which accompany machines have usually been compiled as the result of specific experiments — but as working conditions are so extremely variable such instructions may not always be entirely correct. All the more reason, then, for the operator to know what he is trying to achieve.

Cutting

The *conventional mower,* despite all its shortcomings, is still the most widely used cutting equipment. Underserrated knife sections increase life between sharpenings; improved vibration-dampening devices reduce cutter bar wear; a marked simplification in the design of the frame makes it more convenient to attach to the three-point linkage of the modern tractor and reduces the sources of wear and breakdown. The double-knife mower, comprising a fingerless cutter-bar fitted with two counter-reciprocating knives mounted back-to-back, has performed well. Its particular advantages are an almost complete absence of blockages in wet and dense crops and an ability to work without jamming in stony ground. If it becomes widely marketed it may provide stiff opposition to the rotary mowers which are increasing in use for hay cutting. A real point in its favour is the lower power requirement.

Horizontal rotary mowers, when designed for hay cutting, perform well on smooth-surfaced pastures but do require considerably more power than the reciprocating mower and do not cut any more quickly. They do, however, bruise the crop to a limited degree which will promote more rapid drying, but sometimes have difficulty in separating tangled or lying crops.

Virtually complete absence from blockages when cutting is provided by the *flail mower* and the *flail-type forage harvester.* The former has been designed for hay cutting and does not generate as great an air-blast as the latter. Thus

it requires less power to drive it or conversely can work at a greater speed. A 6 ft wide model can be powered quite adequately by a 35 h.p. tractor for work round 4 to 5 m.p.h. The flails run more slowly than on the flail harvester, do not mince the crop to the same degree, yet provide a very suitable degree of bruising which promotes more rapid drying. If a flail harvester is used for hay cutting, two points must be noted. First, the flails should be turned as *slowly* as is consistent with satisfactory cutting and some device should be used to absorb the velocity of the hay before it hits the ground or the swath must be loosened immediately. Hay-in-a-day is quite practicable with either the flail mower or the flail harvester, given reasonably good drying conditions. For preference, confine the areas to small blocks of 3 to 5 acres, cut in the late afternoon and loosen the swath. Next day turn regularly every two hours or more often, starting as soon as there is warmth from the sun. If there is a light breeze the crop should be ready for baling by early afternoon. If left for too long it may become overdry with subsequent higher losses of material left in the field by the baler.

Turning

An ideal attachment for a conventional mower would be a device which inverted the swath as it was cut, leaving it with the butts up and leaves down. Perhaps this is not possible, in which case the swath should be turned 180° and left about 3 to 4 ft wide in a fluffed-up state. Subsequent turning should move it on to dry stubble and again invert 180° each time it is moved.

The *old-style cylindrical reel rake* with the centre sections removed does this job admirably, two rows at a time, when driven correctly. It is, unfortunately, slow — 4 m.p.h. — but a similar task is done by the *finger wheel rakes*, used in two banks of two reels, at 8 to 10 m.p.h. The swaths should be hit by the second reel in each bank, the front reels being used only to tidy up the loose edges of the swath. The high rate of work allows the constant-turning technique to be fully employed and the low maintenance and minimum of moving parts make it an ideal tool for haying operations. When the hay becomes crisp, harsh treatment must be stopped. For the final raking, set the two banks into one and use a shallow angle. This rolls the crop gently into windrows suitable for baling.

If the *tractor-drawn cylindrical reel rakes*, with no removable centre sections, are used, only the last 2 ft should be employed for turning — one row at a time, 180° turn. In literature accompanying American designed machines, almost invariably emphasis is placed on rolling the mower swath into a hollow cylinder. When used with their full width they perform this operation well but this technique is wrong when applied to general haymaking in most of the North Island and the humid areas of the South Island, except for the final raking prior to baling.

Swath aerators can be useful in dealing with heavy crops or sodden windrows, but the main shortcoming is that they do not invert the swath. Some type of tine attachment should be provided at the rear, not only to absorb the velocity of the hay as is usually done, but also to turn it upside down on to fresh stubble. This point could receive more attention from manufacturers, as it is only by *turning* that a uniform drying rate of the swath as a whole will be achieved. There is no doubt that these machines aid drying by leaving the swath loose and open and providing a modicum of mixing, but their performance could well be improved.

From Germany comes the tractor-drawn version of the tined horse-drawn swath-turner quite popular in pre-war days. The power take-off drive enables wide variation in effect on the swath — from a rapid tearing apart to a gentle nudging. It is available in sizes up to three swaths at a time, is flexible across its width, can be used at 6 to 7 m.p.h., and can tear apart rain-soaked swaths. Its action on mown hay produces good mixing and aeration (if it is not used too quickly) and it moves the hay on to fresh stubble. This certainly helps drying, but again there is no complete inversion and a side rake will still be needed before baling.

The *flail mower* and *flail harvester* can both be used for picking-up and aerating conventionally mown swaths but should be used at the most twice only, and that when the moisture content is above 45% to 50%. With some flail harvesters, difficulty is experienced with the crop wrapping around the rotor, and usually velocity-absorbing tines are needed to stop the crop being thrown forcibly on to the ground. Again, rotor speeds should be as slow as practicable — some operators report a good pick-up using the tractor power take-off in the ground speed position.

Crushing and crimping devices have been in use since the early 1930s. Their effect on the legumes and thick-stemmed grasses is good. Cracking or crushing the stems

promotes more uniform drying and reduces drying time. The effect is primarily a function of the severity of crushing, but when crushing is too severe considerable physical loss of leaf and stem occurs because of the clipping effect. Crimpers cause slightly more loss of clipped leaves and have slightly less effect on drying time than crushers.

Both have less effect in reducing drying time of pasture hay (with a predominance of grass) than machines which bruise or lacerate the grasses; hence the rapid drying possible following the use of the flail mower or flail harvester.

Whatever swath treatment is used, whether side rake, aerator, crusher, crimper or flail, it should be done *immediately* after mowing, preferably in tandem with the mower. Physical losses following these treatments can be quite small, provided the material is not chopped too finely or crushed too severely. Reduced speed of drying is the only effect of a delayed treatment. There is no point in bruising or crushing a crop which has wilted. Crushed, crimped or lacerated grass will not dry quickly and evenly unless it is frequently turned, or aerated, thus another machine will be needed.

Aerating or turning with a machine which leaves the hay in a fluffy windrow on a fresh piece of ground, used immediately behind the mower, and frequently thereafter, is the best treatment for general conditions. When moisture has been reduced to about 30% to 35%, turning should be the only treatment and this done gently. Rain causes leaching of nutrients from partly dried grass — no matter how it has been dried. Thus these quick-drying treatments are important as they may allow the hay to be dried without a shower.

Swathers are being used increasingly for hay-making, especially lucerne hay. Currently, the self-propelled models with a 10 to 16 ft cut and equipped with a crimping or crushing device are being featured. The main objective is to cut the crop more quickly (they can work at 7 to 8 m.p.h.) but the large windrow left is not generally suitable under New Zealand drying conditions. In arid areas and light crops, cutting a wide swath, crushing and windrowing in one operation makes sense. In humid areas and heavy crops, the recommendation is to take a narrower cut and team up with some form of artificial drying. If it is used for cutting pasture hay, the windrow should be split into two to aid drying. However, it is not recommended for pasture hay. Obviously, swathers are more suited for large acreages and

flat or smooth-surfaced land where their high cutting rate can be utilized to the full. Performance in heavy or tangled crops is surprisingly good, primarily because of the special pick-up reel which sweeps the crop off the cutter bar.

Baling

For the single-labour unit farm, the *"roll-up" baler* obviates the urgent need to collect and store bales safe from the weather. Even if it does rain the bales will come to little harm in the field. Once the correct technique of forming a satisfactory windrow has been mastered, and if a tractor with a live power take-off is used, most of the criticisms of this baler are nullified. It is a pity that more of these machines are not on the market.

Self-propelled rectangular balers are available, but these seem to be an economic proposition only for a contractor with a long season.

The live power take-off on current tractors makes a *power take-off driven baler* an attractive proposition, especially since timeliness is so important when baling for quality. Some balers are available with a two-universal joint drive-shaft which permits the elimination of any fluctuation of the drive to the baler when negotiating turns, provided the hitch point is mid-way between the universal joints. With three-joint systems, it is necessary to provide the correct hitching arrangement, otherwise sharp turns cannot be negotiated, and breakdowns in the drive to the baler are likely — if not this season, the next.

Bale storage provides a labour problem, and it is surprising that more farmers are not storing their hay in the long form. The use of a front-end loader and push-off sweep takes all the hard work out of stacking, requires only two labour units — one on the loader and one stacking — and, for feeding out, the sweep can be replaced by a grab.

Bale throwing attachments which randomly stack a towed trailer require to be teamed up with an elevator system to unload the trailer and random stack the bales in the barn. This method has much to commend it from the viewpoint of labour reduction and adequate ventilation of the bales in storage, and surprisingly requires only an additional 15% more storage space.

The main criticism of bale-handling equipment is that, although the various devices usually do perform their separate functions satisfactorily, they are only individual units in a chain of operations which are connected by hand

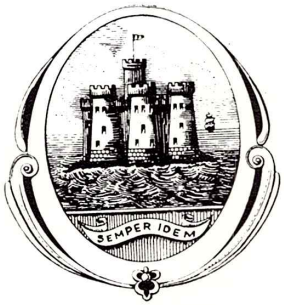
physical effort. The whole movement of the hay from the windrow, into storage, and then to the stock should be considered in its entirety. The overall system should eliminate unnecessary operations and the duplication of effort so evident in the present-day piecemeal approach, when bales are dropped on to the ground from the baler to be elevated and hand-stacked on to transport, to be off-loaded and hand-stacked into storage, to be hand-loaded on to transport, to be hand-distributed to stock.

If the hay is to be used only on the farm, there is no need for baling, and the use of loose hay is a much more attractive proposition, both physically and economically. An alternative method for the complete mechanization of the movement of hay from field to stock is to chop it into short lengths, convey it pneumatically into storage, and auger it to the stock-feeding troughs. Hay cut with the flail mower or flail harvester could probably be handled in a similar fashion. The example afforded by the complete mechanization of silage handling from the field through to the stock cannot be ignored.

Conclusions

A considerable overall improvement in hay quality is possible in the first instance by a better understanding of the principles of drying and a more conscientious application of the constant turning technique. Probably the most significant fact to come out of haymaking trials at Massey in which the flail was compared with the conventional mower was that, although hay in 24 hours was possible with the flail, in all three trials hay cut with the mower and turned every two hours was ready for baling within 48 hours.

If sufficient justification can be shown for the purchase of other specialized mechanical aids, many of which are not cheap but can have alternative uses to help offset their cost, then their correct employment will further hasten field drying. One further plea — thoroughly understand the purpose for which the aid under consideration was originally designed. If that purpose fits in with the requirements of the particular farm, then learn to use it correctly to achieve its designed purpose.



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CHEMICAL PASTURE RENOVATION

L. W. BLACKMORE*

Introduction

METHODS of improving pastures fall into two main categories — surface methods and cultivation. A comparatively new method known as chemical renovation in which grass-killing chemicals are employed to accelerate pasture improvement has come into prominence in recent years. The idea of using chemicals for improving pastures is not advanced as an alternative but rather as a complementary method to those already in use. Each method has its advantages and its limitations. The chemical approach brings with it certain advantages the others do not possess.

It should be stressed that the chemical methods of renovation which are described in this paper apply more to country which can be traversed by ground equipment. It is necessary to point this out because most people associate the method only with the improvement of hill country. Results have, in fact, been progressively more rewarding with increasing soil fertility.

THE METHOD

The object of chemically renovating a pasture is to change its composition and nutrient status in a desirable way without destroying it. The grass-killing chemical paraquat has proved to possess some excellent renovating qualities. It has the ability to selectively kill grasses and leave the clovers. It is rapidly absorbed by foliage and breaks down on contact with the soil.

The method used is to apply from 2 oz to 8 oz active ingredient (a.i.) of paraquat (½ pint to 2 pints) in not less than 20 gal of water per acre using a suitable spreader. The pasture should be evenly short at the time of spraying, the herbage not exceeding an inch in height and preferably less. One to three days after spraying the pasture turns a characteristic straw colour. The seed can virtually be sown as soon as the spray has dried on the foliage.

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The Seedbed

A chemically produced seedbed consists of three main components: the mulch formed by the killed turf, worm casts, and clover which has recovered after spraying. All of these play their part in covering and protecting the seed.

Strikes from seed sown on a chemically prepared surface have been very encouraging. Rates of 10 lb to 15 lb of grass seed per acre (including some Italian and short-rotation ryegrass) on dairy and export lamb farms, and 20 lb per acre for aerial sowing have resulted in surprisingly good strikes. It is considered that in most cases rates could be further reduced. Where pastures are conventionally established, a fair amount of grass seed is sown because grass is the main source of feed, while the resulting cover provides competition for any weeds present. Where the chemical method is used, the recovery clover tends to provide both the bulk of the feed and competition for weeds.

Some Basic Concepts

Changing Composition

The composition of a pasture is continually changing and is governed by climatic conditions, soil fertility, grazing management, etc. The composition at any particular time is the outcome of a fierce competition among the species present for survival. If a grass-killing chemical is used, the *status quo* is immediately upset. Plants killed by the chemical leave bare spaces. Those affected in varying degrees are suppressed by those which are least affected and a complete resorting of material ensues. A plant's share of the available light, nutrients and moisture in the struggle that follows determines its chances of survival. As clovers are highly resistant to paraquat, they usually recover rapidly and invade the areas formerly occupied by grasses. Where grass-seed is sown, this strikes wherever it can find a suitable place amongst the clover or in dead patches of grass. The rotting of dead turf which commences shortly after spraying results in a temporary nitrogen (and probably mineral) deficiency which tends to delay clover recovery and seedling establishment, especially if the weather following spraying is cold. However, later on the characteristic increase in fertility resulting from turf breakdown and from nitrogen produced from the increased proportion of clovers boosts the good grasses.

Clover and Grass

This concept is based on the differing seasonal growth patterns of the two basic components of pasture — grasses and clovers. By the use of grass-killing chemicals, the proportions of these at any particular period of the growing season can be substantially changed. This gives a flexibility not previously enjoyed and if fully exploited can lead to exciting possibilities. The ability to change the composition of a sward in the past has been very limited and uncertain.

Mobilization of Mineral Resources

Ideally, the organic cycle operating in a soil-pasture-animal complex should be aimed at keeping the maximum quantity of minerals in a form available to plants (or, conversely, the minimum amount immobilized in organic form) through the maintenance of small root systems, minimum accumulations of organic matter, optimum plant numbers within reasonable limits, and the maintenance of clover/grass ratios that will ensure an adequate nitrogen supply to allow the maximum utilization of the minerals so released. Conversely, the congestion of swards with grasses, the development of extensive root systems, and the accumulation of organic matter are associated with pasture deterioration and diminishing cyclic activity. Where this state occurs, the use of grass-killing chemicals should be of considerable value by reducing plant numbers and increasing the proportion of clover. By raising the fertility status through organic matter breakdown and the extra nitrogen from the clovers, the plants would not need such extensive root systems. Little work has been done on the amounts of dry matter involved in the root systems of pasture plants but Scott has estimated the root weight of a medium to good permanent pasture on a yellow-grey earth to be 8,000 to 10,000 lb dry matter per acre for the top 3 in. of soil. It is likely that the dry matter in the form of roots in poor pastures is well in excess of this figure as the root systems of these are typically extensive and combing. The quantity of minerals immobilized in this mass must be considerable.

Timing of Operations

The times at which changes with grass-killing chemicals are initiated must be within the growing period. However, the "safe" period will vary with climatic conditions and extends over a much longer period for areas of abundant

rainfall. Favourable weather (rain and warmth) must follow within a reasonable time of spraying so that the damage inflicted on the pasture can be repaired and the change which has been initiated brought to fruition. Timing is of the utmost importance in dry climates as spraying during unfavourable periods may result in an extended loss in production. In such climates the use of chemicals should be confined to autumn renovation and the use of light rates (without oversowing) in the spring so that quick recovery can take place.

Minimum Rates of Chemical

The least rate of chemical that will effect the desired change should be used. Excessive rates, besides adding to the cost, defeat the purpose for which they were applied by delaying pasture recovery. They may also lead to an excessive clovery state in the initial stages and an inevitable swing back to excessive grassiness within twelve months (boomerang effect). Excessive rates could conceivably lead to a nitrogen loss on free-draining soils through large amounts of nitrogen being produced by the clovers and from an extensive organic matter breakdown.

Recovery Rate and Management Effects

The effectiveness of paraquat depends not only on the amount of active ingredient used, but also on the recovery rate of the pasture and the management it receives after spraying. The rate of recovery of the plants surviving spraying (together with the growth of any oversown species), the height to which the pasture is allowed to grow, and the period for which the area is spelled, can all have a profound effect on survival of the original species. Where competition from these factors is strong enough, grasses which would otherwise recover from spray effects die because they fail to get their share of light, nutrients, and moisture if these are in short supply. In other words, the selective effect between those species which are least and those which are most affected by the spray is greatly increased. In such circumstances lower rates of chemical can be exploited.

Applications

The use of chemicals to renovate pastures should be looked upon as a complementary rather than an alternative

method of improving pastures. It provides an additional management tool for achieving these aims over a wide range of soil types and climatic conditions. Chemicals can be used for opening up excessively grassy swards, for rapidly increasing the clover fraction, introducing good type grasses in quantity, arresting pasture deterioration and improving palatability, etc. By speeding up the processes essential for pasture improvement, they can materially assist in breaking down sward resistance which would otherwise have to be done largely by the animal at the expense of stock thrift and productivity. ("Sward resistance" means the resistance of the sward to change by management methods.)

Adjusting the Clover/Grass Ratio

Where a pasture has become excessively grassy, the removal of a proportion of this grass allows the clovers to occupy more space and so produce a greater supply of nitrogen. Any surviving grasses (and any new grass plants established by oversowing) have more room in which to grow and benefit from the extra nitrogen produced by the clovers and the plant nutrients released as a result of organic matter breakdown.

Introducing Desirable Species into Existing Swards

There would appear to be a big potential here as the method provides a valuable means of readily incorporating into pastures improved species produced by the plant breeders.

The Creation of Special-purpose Pastures

Chemicals open up the way for the creation of special-purpose pastures from existing swards without destroying their basic components. In this way quick growing, temporary and palatable grass species such as short-rotation ryegrass, Italian ryegrass, or Western Wolths could be introduced to provide additional winter and early spring feed. While overdrilling without the use of chemicals would achieve a similar result, its application is restricted to clover-dominant pastures of easy contour. The only other way of obtaining these grasses in quantity would be by cultivation and this would involve clover establishment problems and frequent renewal.

Another type of special-purpose pasture that could be developed would be a cocksfoot- or timothy-dominant pasture or a cocksfoot/timothy pasture, as both species are considerably more resistant to paraquat than ryegrass. Such pastures could be built up after a few years by spraying and sowing extra cocksfoot and/or timothy.

Lamb Fattening

The typically improved clover content of autumn renovated pastures appears to have a very favourable effect on lamb growth rates. It also appears to have a marked effect on the weight and thrift of ewes. Whether the results with lambs are mainly due to the presence of considerably more clover than is normally present in other pastures during August, September and October, or is also due to a better milk flow of the ewes (possible oestrogenic effect) needs to be investigated. So, too, does the possibility of early weaning (say, at 8 weeks) to avoid excessive fatness in the ewes and lambs and concentration of extra lambs on renovated pastures.

The use of low rates of paraquat 1⅓ to 2 oz a.i. (⅓ pint to ½ pint) during the spring to summer period, especially for the provision of clover dominance for lamb fattening offers good prospects in areas of good summer rainfall.

Provision of Additional Winter and Early Spring Feed

Under conditions of high fertility and good summer rainfall, autumn renovation accompanied by the oversowing or overdrilling of Italian or short-rotation ryegrass will provide extra feed during the winter and early spring periods. However, renovation must be done during late summer or early autumn and a low rate of paraquat (2 to 3 oz a.i.) should be used to allow quick pasture recovery. A better approach which may also be applicable to areas of lower fertility and rainfall would be to make a split application of paraquat — the first during the spring-early summer period to create clover dominance and initiate a partial breakdown of organic matter with the object of substantially raising the fertility level. The second application of paraquat could then be applied during the early autumn accompanied by oversowing or overdrilling of the seed. Relatively low rates of paraquat of the order of 2 oz. a.i. per acre should be adequate.

TRANSFERRING OF SURPLUSES

The concept here is to renovate during or preferably in anticipation of a period of flush growth to help prevent surpluses occurring and subsequently reaping the benefit of extra feed during a period of shortage. Such an approach would give a triple advantage. It would assist in better pasture control and reduce the need for extra stock; the fertility of the renovated paddock would be substantially raised through an increase in clovers and through organic matter breakdown; while the extra feed subsequently produced during a period of reduced growth would be of considerable value. Three instances where this principle could be put into practice are:

(a) *In the late-spring, early-summer to produce a clovery paddock for fattening lambs after weaning*

This would apply on farms normally experiencing difficulty in controlling growth at this time or in a growthy season in drier districts. Early action would be essential for success so that pastures over the remainder of the farm could be held at the optimum stage for lambs. The method could reduce the need for buying as many cattle in the spring when surpluses arise. Given suitable weather, the renovated paddocks would produce good lamb feed. Where conditions remained growthy, part of the renovated area could be saved for late hay, which should be of good quality.

(b) *In the late-spring, early-summer, to produce extra feed for town milk supply herds during the late autumn, winter and early spring*

There is normally a large surplus of feed on town milk supply farms during the late-spring, early-summer period. The use of chemicals to help control feed at this time could be of value, especially in wet seasons when the saving of hay and silage is difficult. Overdrilling in early autumn on the resulting clover-dominant sward with short-rotation or Italian ryegrass, or broadcasting the seed using a further low rate of paraquat to assist establishment, should allow full exploitation of the raised level of fertility and result in a valuable supply of feed from late autumn through to the spring. It will be of interest to see the value of the new tetraploid Western Wolths being bred by Barclay at the Grasslands Division, D.S.I.R., for this purpose.

(c) *During the early autumn flush to produce extra feed in the spring*

This applies to areas with good summer rainfall and a late spring. In these areas feed surpluses during the late-spring, early-summer are not a problem but considerable surpluses typically occur in the autumn. Renovation done in the late-summer, early-autumn period could produce valuable feed during the following spring when feed is normally in short supply.

Improving Hay Quality

For pastures that are too grassy and contain a low clover content, the use of a low rate of paraquat (1 oz to 1⅓ oz a.i.) prior to closing up for hay have substantially improved hay quality. Treatment should be as early as possible. Results could be disappointing where dry weather occurred after spraying. It is essential to avoid the use of heavy rates of paraquat at this time where Californian thistle is present as this weed can be encouraged in this way.

Improving Clover Seed Yields

In seed-growing districts, the use of paraquat can substantially increase white clover seed yields in pastures which would otherwise be too grassy to save for seed. The rates to use to suppress the grass and produce clover dominance have been fully investigated by Leonard.

Techniques under Investigation

Split Applications

It is thought that two half-rate applications of paraquat may prove more effective than a single full application. For instance, 2 oz a.i. applied in the spring followed by a further 2 oz a.i. in autumn may prove a better proposition than 4 oz a.i. applied in the autumn. The 2 oz application in the spring would be applied without seed and would favour a substantial increase in clover. The nitrogen release from this source plus the nutrients released from organic matter breakdown would result in a substantial lift in fertility by the autumn. If the second 2 oz rate was then applied and the area oversown, recovery of the clovers and establish-

ment of the sown seed should be rapid. For comparison, the 4 oz rate would also be applied at this time and the area oversown.

Spray-seeding

Spray-seeding is a technique for renovating pastures whereby a tractor or other vehicle is equipped to spray and sow in a single operation. This technique would have the advantages of reducing by half the time and application costs of renovating. This would be of special significance where operating costs are high, as they are for crawler tractor and for aerial work.

Trial work carried out this autumn shows quite clearly that severe germination injury occurs where paraquat is sprayed directly on to most grass seeds. Clover seeds, on the other hand, appear to be entirely unaffected. However, where spraying is done first and grass seed is sown immediately after (spray-seeding) germination injury is considerably reduced. In fact, it would appear to be fairly safe to spray-seed a pasture where a rate of 2 oz a.i. or less of paraquat per acre is being used. Because of overlap effects with the spray and spray drift, rates above 2 oz a.i. may significantly affect germination. Preliminary trials have shown that bentonite clay dusted on to perennial ryegrass seed will give a fair measure of protection from paraquat injury, while bentonite clay dusted on to gelatine-coated seed will give complete protection even where the seed is directly exposed to high rates of active ingredient.

Progress on Various Types of Country

Approximately 250 acres of hill country pasture have been renovated by aerial means during the past autumn and about 2,750 acres represented by over 300 paddocks have been renovated using ground equipment.

The use of grass-killing chemicals for the improvement of hill country pastures and especially those too steep or difficult to cultivate has been regarded as the logical sphere of development. But, contrary to expectations, the method has made much greater progress on the flat and easy country where ground equipment has been used. Why has the hill country lagged behind? The main reasons for this appear to be as follows:

(1) Aerial spraying is more uncertain than ground spraying. With aerial spraying it is more difficult to get the

spray down on to the pasture owing to air movement, convection currents, and fine spray particles becoming airborne. The drift problem on to crops and shelter belts is correspondingly greater.

(2) Costs are substantially higher than where ground equipment is used, but are considerably lower than for cultivation.

(3) Low-fertility grass species, such as danthonia, Chewing's fescue, and ratstail, are not very susceptible to paraquat.

(4) Recovery of the clovers and establishment of the sown species are slower. This has two important effects. Slow recovery of the clovers means that the suppressing effects they have on any of the original grasses struggling for survival is of little consequence, while a relatively small population of insect pests which would otherwise have no appreciable effect may cause considerable seedling mortality.

In spite of the difficulties outlined, the results to date on hill country have been satisfactory. While there are more problems on the hills, these will be overcome in considerable measure in the future. The following would help:

A new grass-killer with similar qualities to paraquat but a better killer of low fertility grasses.

Improved spraying techniques.

More effective insect control.

The place of paraquat on hill country would seem to be on browntop-dominant swards where good type clover has been successfully established, and on considerably improved hill country. Paraquat has given progressively rewarding results with increasing fertility where ground methods have been used and there is no reason to believe that this would not apply to hill country. Somewhat lower rates of paraquat could no doubt be used than on lower fertility country, while spraying could be done with and without oversowing according to circumstances.

Its value on country consisting of dominant danthonia, Chewing's fescue and ratstail is very doubtful.

Costs

The costs of application of paraquat on different types of country are given in Table 1.

TABLE 1: COSTS PER ACRE OF PARAQUAT APPLICATION

EASY COUNTRY (NO SEED)		
Paraquat 1 to 2 oz active ingredient (a.i.)	7s. 6d.	15s. 0d.
Spraying	15s. 0d.	15s. 0d.
Total	22s. 6d.	30s. 0d.
EASY COUNTRY (WITH SEED)		
Paraquat 2 oz. to 4 oz. a.i.	15s. 0d.	£1 0s. 0d.
Spraying	15s. 0d.	15s. 0d.
Seed 5 lb to 10 lb	7s. 6d.	15s. 0d.
Sowing	10s. 0d.	10s. 0d.
Total	£2 7s. 6d.	£3 10s. 0d.
EASY TO CRAWLER COUNTRY (TOUGH SWARD)		
Paraquat 8 oz. a.i.		£3 0s. 0d.
Spraying*		15s. 0d.
Seed 15 lb		£1 2s. 6d.
Sowing*		10s. 0d.
Total		£5 7s. 6d.
* Crawler tractor: £1 0s. 0d. extra.		
AERIAL APPLICATION		
Paraquat 8 oz. a.i.		£3 0s. 0d.
Spraying		£2 10s. 0d.
Seed 15 lb		£1 2s. 6d.
Sowing		7s. 6d.
Total		£7 0s. 0d.
3 cwt superphosphate @ 15s. cwt		£2 5s. 0d.
Total		£9 5s. 0d.

Conclusion

There are many problems requiring investigation, not the least being the economics of the improvement of hill country by chemical means, cultivation, and by oversowing and topdressing; but sufficient evidence has been presented to indicate that the use of chemicals for renovating pastures has come to stay. Just how the method will dovetail into present practices has yet to be worked out. There are at present a number of limitations, such as the resistance of certain grasses to grass-killing chemicals, but the method is still in its infancy, and there is little doubt that a wider selection of chemicals will become available in the future to extend its application.

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THE IVON WATKINS-DOW GROUP OF COMPANIES

ELECTRIC FENCES FOR SHEEP

L. H. WESTON*

Introduction

THERE HAS BEEN some criticism recently of electric fencing, on the grounds that too much time is spent checking it. Consequently farmers are said to be replacing it with ordinary type fences. However, enquiries among a number of farmers in Otago have indicated that most are quite satisfied that there is a place for electric fencing on their farms; some were continuing to erect more of it. These enquiries led to the conclusion that electric fencing is proving satisfactory, provided strong electric impulses are maintained, or, on the other hand, provided the fence itself is fairly robust.

Thus, an early type electric fence with standards up to 18 yd apart, with tight wires clear of vegetation, is satisfactory if a good reliable electric controller is used. On the other hand, where a six-wire fence was erected with standards 7 yd apart, little trouble has been experienced, even though there is a low voltage impulse some of the time.

The extremely light-weight electric fence is almost certainly doomed to failure, if other fences on the farm are poor and not respected by the stock. The better quality electric fence will certainly prove successful when stock are trained to it. Raising the height to 3 ft 6 in. with an additional wire will be necessary where cattle are used to jumping fences. This will not be required on steep hillsides, of course.

Experiments

CONTROLLERS AND INSULATORS

To find out how electric fences could be made satisfactory, a series of experiments and tests has been conducted with the assistance of the Physics Department of the University of Otago. Measurements taken on existing fences were used to design a test for electric controllers. Typical results from these tests are shown in Table 1.

TABLE 1: ELECTRIC FENCE CONTROLLER VOLTAGES

Controller	*Good Fence*	*Poor Fence*
6 V wet battery unit	850	380
9 V dry battery unit	1,640	400
12 V wet battery unit	2,500	2,200
Average mains unit	2,040	960
High power mains unit	2,570	2,350

* Farm Machinery Officer, Department of Agriculture, Dunedin.

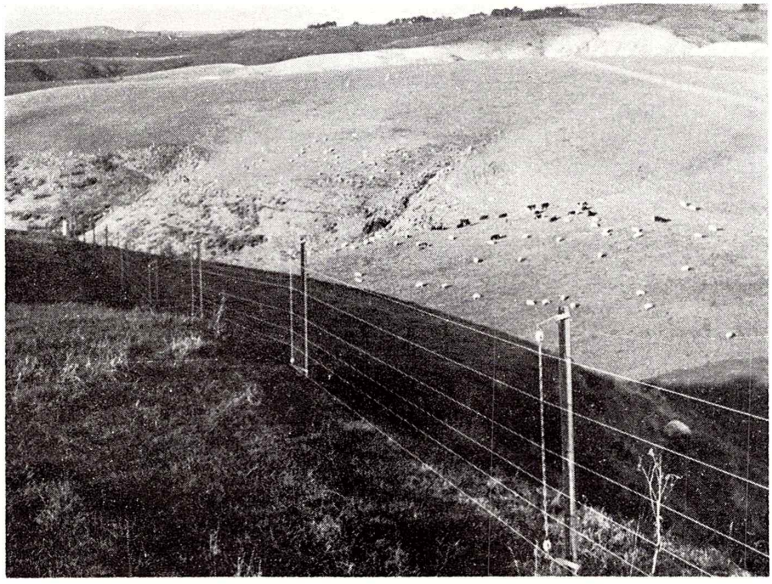

FIG. 1: *"Waratah" standards 7 yd apart; six 12½ gauge high-tensile wires well tensioned; a "mains" electric fence unit and continuous earth wire connected to it are the reasons for the success of this fence.*

Insulators, too, have been tested. It has been found that there is little difference between the insulators commonly used, porcelain or polythene, at the voltages encountered on electric fences.

However, experience has taught that insulation is important when a low power battery unit is being used. On one fence in mountain country, porcelain insulators have developed surface cracks which hold moisture and allow the electric charge to leak away. Under normal conditions, porcelain insulators should not give any trouble, if those which have cracks are discarded before putting up the fence.

Polythene insulators are proving to have quite a long life, but care must be taken not to place too much weight on them. High density polythene is available if farmers are cutting insulators from half inch pipe. This does not soften in hot weather.

EXPERIMENTS WITH SHEEP

To discover the voltage necessary for sheep, a temporary fence was used to confine some sheep on a bare paddock.

Hay was laid out on the other side of the fence which was not electrified at first. For some days the sheep pushed through it at will.

Then the experiments were begun. It was found that, once sheep had their heads through the fence, they felt nothing through their wool. The wire spacings were adjusted and the fence was electrified at increasing voltages until the sheep were affected. At 450 V several received shocks and retreated hastily to the far corner of the field, followed by the others. Eventually the sheep learned to respect the fence.

These experiments proved that, if electric fence wires are tight and well spaced, 500 V will be satisfactory.

Electric fence testers which indicate the voltage are available, costing about £3. On the dial type, a satisfactory voltage is indicated when the needle flicks half way into the yellow portion. With the six-light indicator, four lights is a satisfactory level, but the tester should be shaded and watched closely, or the flashes may not be seen.

Recommended Fence

From these results it was clear that a six-wire fence was needed to hold cattle and sheep, by providing a satisfactory wire spacing and a reasonable height.

In practice, it has been found essential to connect the earth terminal of the unit to a continuously connected earth wire running the full length of the electric fence. Where wooden posts are used, the earth wire is not grounded, so earthing spikes should be fitted every five chains or so, and the alternate live/earth system should be used.

Where vegetation — grass, thistles, scrub, gorse, etc.— cannot be kept in check, and a low-powered battery controller is to be used, two earth wires, at the bottom, should be used. This is easily done if separate insulators are fitted to standards, and is possible with chain and brackets if 6 ft standards are employed. A 3 live/3 earth wire system is recommended for hill country.

Construction Procedure

(1) After siting, the fenceline may be bulldozed, either to clear vegetation, or to make the fencing easier. By "dozing" in rough country, many tiedowns can be avoided, particularly if small hollows are built up afterwards with turf, or by using the tractor.

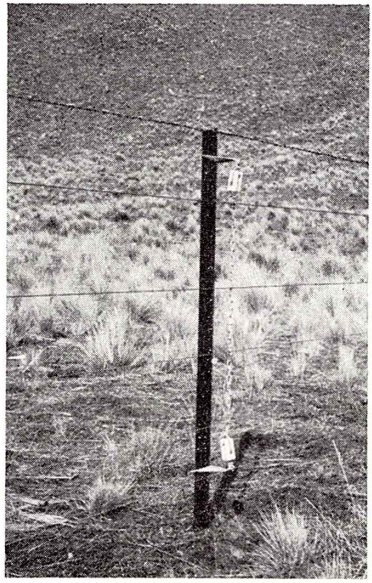

FIG. 2 (*left*): *Where cattle are inclined to jump fences, the height of this type of fence can be raised by replacing standards with 6 ft "waratahs" and adding a barbed or plain wire to the top.*

FIG. 3 (*right*): *Economical 3 ft electric fence support composed of "bobbin" insulators on a 5 ft 6 in. standard driven in to give a 3 ft high fence with six high tensile steel wires. Cost of "waratah" and insulators complete is 7s.*

(2) Strainer and corner posts are put in and the wire positions marked.

(3) Insulators are fitted to these posts.

(4) A guide wire, usually the bottom earth, is run out.

(5) The wire is pulled down into deep hollows and fastened to a main tiedown. The earthwire is connected below the insulator.

(6) Standards are driven at approximately 7 yd intervals, set back 3 in. from the wire if brackets and chains are to be used.

(7) The earth wire is attached, below the insulator again.

(8) The remaining wires are pulled out, and lightly strained.

(9) Additional tiedowns are fitted where required; then wire tensions are finally adjusted. Permanent fence strainers make regular checking of wire tensions an easy task.

Construction Points

Wire

12½ gauge steel wire is very suitable for electric fences, except where fire is a possibility. Then 10 or 11 gauge ordinary wire could be used instead. Figure eight joints have proved satisfactory — it is not necessary to joint wires with chain or insulators. A simple twist joint with the ends bent back and locked together has also proved satisfactory.

When threading wires through standards, etc., an endeavour should be made to keep the zinc coating intact. Punched holes have one side with a smooth edge, so threading should be from that.

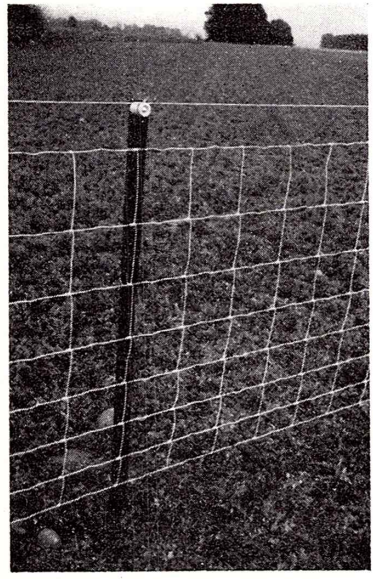

Fig. 4 (*left*): *"Bobbin" insulators attached to chain held down by half a 6 ft standard makes an effective tiedown.*

Fig. 5 (*right*): *A single electric wire can profitably replace barbed wire along the top of a netting fence. Few posts are required and standards can be spaced 5 yd apart. All-electric fences and break-feed fences can be attached to the live wire whenever required.*

"Lead-out" Wires

"Lead-out" wires of 14 gauge wire can be attached to poles about 2 chains apart, to connect a fence on to a mains controller at the nearest power point.

If there is some distance to go, a better idea is to insulate the top wire of a fence. In fact, some farmers are using netting fences and a top live wire, with great success, doing away with intermediate posts and barbed wire. A 30 in. netting with 8 high tensile live wires and 6 in. stays seems to be very suitable for this purpose.

Gateways

It has been suggested in the past that a section of well-constructed netting fence was necessary beside gateways. However, many farmers find it easier and simpler to put in a few extra standards, leaving the first half chain "dead" to save insulators. The top wire can be insulated to take the electricity.

The common practice nowadays is to dig underground a plastic covered cable. The earth wire connection should go underground, too, and all joints should be good electrical joints, protected with tape.

Length of Fence

In spite of the claims made by some manufacturers, the length of fence that can be effectively run by one controller is rather limited. The writer's recommendations are 2 miles for the average battery controller; 4 miles for the average mains unit; 6 miles for the high power mains unit.

"Lead-out" wires, even though they are several miles long, need not be taken into account if good quality insulators are used.

Costs

STANDARDS

Including the cost of 6 ft Y-standards, chain assemblies of the all-electric, or alternate live/earth types range from 12s. to 14s. In comparison, three individual insulators of plastic or porcelain, wired or bolted to a "waratah" as the case may be, can be obtained for from 6s. to 10s. Only 3d. is saved by using 5 ft 6 in. "waratahs".

Tiedowns

Patent tiedowns cost 9s. to 13s. complete. Home-made tiedowns of chain, insulators, stainless steel wire and half standards cost from 4s. 3d. to 6s. 7d. If whole 5 ft 6 in. "waratahs" are used, the costs range from 6s. 7d. to 11s. 9d.

Ordinary Fences

Subdivision fences of a good type cannot be erected for much less than £500 per mile, employing contract fencers at £2 per chain.

Electric Fences

Costs range from £250 per mile for a six-wire electric fence erected by contractors at £1 per chain, up to £400 for a more expensive chain assembly type of fence. These costs reduce to £170 and £320 if the farmer himself builds the fence.

Cheaper fences can be erected, of course, and will be reasonably successful, too, if the six wires are kept tight; if the standards are no more than 15 yd apart and, most important, if a strong, reliable controller is used. Such fences, however, will probably give trouble from time to

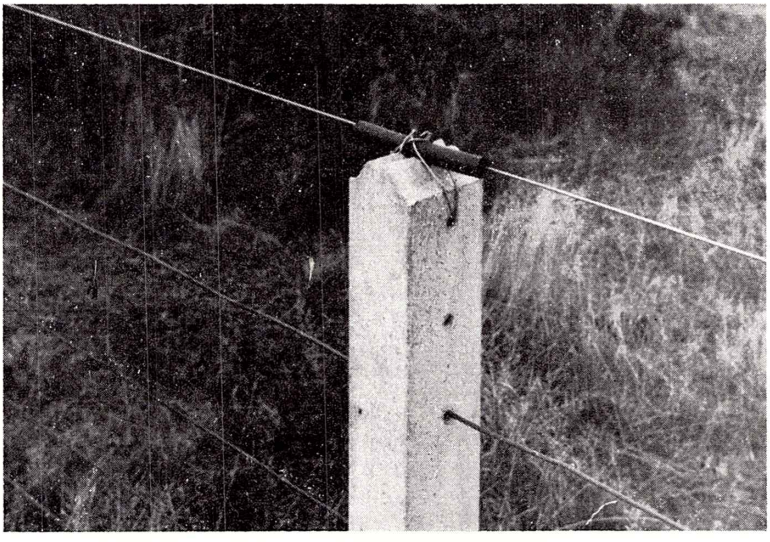

Fig. 6: *An electric wire can be fixed along the top of a 7-wire fence provided battens, droppers, etc., are shortened to leave the top wire clear. Five-inch lengths of polythene water-pipe make cheap insulators. The harder grade, high density polythene is recommended.*

time, and may not be really permanent fences until the number of standards has been doubled.

On the other hand, the new high-powered controllers have not been available for long. It has been found that they are capable of electrifying considerable lengths of ordinary fence. Perhaps cheaper electric fences will prove satisfactory with them, but, in the meantime, a permanent electric fence should contain six wires, on standards 7 to 8 yd apart.

Summary

1. Electric fences can be permanent if:
   (a) Supporting standards are spaced about 7 yd apart.
   (b) Six wires, well spaced, are used for sheep and cattle.
   (c) An impulse of 500 volts is maintained fairly continuously.
   (d) The fence is well constructed and properly maintained, with particular attention to floodgates and tiedowns.
   (e) An additional wire is added where cattle are inclined to jump.
   (f) Ordinary fences with a top live wire are erected along boundaries or where growth of scrub, gorse, etc., cannot be controlled.
2. Electric fencing can be cheaper than ordinary fencing owing to:
   (a) Savings in costs of materials — £150 to £250 compared with £300 to £500.
   (b) Cost savings on transport both to the farm, and on to the fenceline.
   (c) Erection cost savings; approximately £1 per chain contract price compared with £2 or more for ordinary fencing.
3. Because there is less work in erecting an electric fence, farmers are often able to do this themselves, avoiding possible delays, and reducing expenditure.

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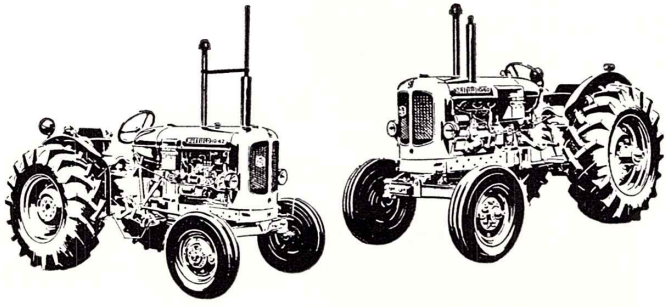

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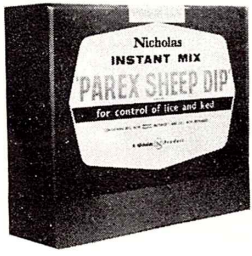

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BOOK REVIEWS

(Reviewed by R. A. Barton)

AUSTRALIAN TROPICAL BEEF CATTLE, by Ian Gibson (1963). 152 pp., illus. Northern Aspect, Townsville, North Queensland. Price £2 2s. 0d. (Aust.).

THIS is a lively little book containing articles by cattlemen and extension workers and is written for cattlemen in the tough tropical environment of Northern Australia and New Guinea. It deals with the failure of the British beef breeds in that environment and traces the history of the introduction of Zebu or Brahman (*Bos indicus*) blood into the herds there. Data from several sources are presented to show the superiority of cattle with Zebu or Brahman blood over those of pure British stock (*Bos taurus*) under these extreme conditions. The story is convincing and one is left with the impression that this vast territory will be populated with cattle fitted to the rigours of the hot and humid environment and resistant, in large measure, to the cattle tick. The quality of the beef produced by these cattle will be acceptable and their reproductive rates, weights of their calves at weaning, and their subsequent growth rates will be substantially better than the production of the existing British cattle under these conditions.

By crossing British cattle with Zebus, new breeds have been created in the U.S. and Australia and these have been named Braford, Brangus, Droughtmaster and Santa Gertrudis. Each of these breeds is playing its part in the cattle industry of Northern Queensland. The story of their development, as set out in the book under review, is a fascinating one and should be read by all interested in beef production.

Four lectures which had been given at two cattle schools by officers of the Queensland Department of Agriculture and Stock are published in the book. These clearly indicate that there is a scientific basis for the superior performance of the Brahman or Zebu type cattle and their crosses in the tropics. The final pages of the book are devoted to advertisements and a directory of breeders of the above-mentioned breeds. The regulations and standards laid down by each of these breed societies are also presented.

As a promotional book it will be highly successful and it cannot fail to have an important impact on the breeding practices of the region.

BEEF CATTLE SCIENCE, by M. E. Ensminger (3rd edn, 1964). 822 pp., illus. The Interstate Printers and Publishers, Danville, Illinois. Price £4 5s. 0d. (N.Z.).

IN THIS third edition, Dr Ensminger changed the title from *Beef Cattle Husbandry* to *Beef Cattle Science* as he believed the new title matched the recent spectacular scientific developments in the American beef cattle industry. In the ten or so years since the first edition appeared, there have been important changes in the industry. Thus beef breeds have been created (the Santa Gertrudis, Beefmaster, Charbray, and the Brangus); performance testing has become widely employed as an aid to the selection of superior stock; artificial insemination is being increasingly used in both commercial and pedigree herds; feeding practices have changed greatly so that pelleted feeds are commonplace and hormone and other accessory ingredients are almost universally incorporated in the ration; diseases are now better controlled. These and other advances have resulted in a greater consumption of beef in America; it has jumped from 63.4 lb *per capita* in 1950 to 94.6 lb by 1963.

Beef Cattle Science covers a wide field and each of the 26 chapters is set out clearly. The author has wisely sought the assistance of recognized authorities in the preparation of certain sections and chapters and he freely acknowledges the help given by veterinarians, physiologists and nutritionists.

The book contains a large collection of line diagrams and half-tone blocks but some of these could have been discarded as they fail to portray anything of real value to the reader. A number of typographical errors were also noted.

Some sections have not been brought up-to-date to the extent indicated in the preface. For example, bloat on pastures is treated quite superficially and the author states on p. 367: ". . . it appears that anything that will tickle the animal's belching mechanism — thus causing it to belch rather than permitting it to blow up like a balloon — will reduce the hazard. Coarse dry roughages appear to have this effect."

Recent research findings have indicated that the stimulus initiating the eructation reflex is generally believed to be due to a stretching of the stomach wall. This can occur where there is an insufficiency of roughage, as is the case with clover bloat. Furthermore, the belching rate may actually be increased at least in the early stages of the onset of legume bloat.

The animal husbandman and the veterinarian should have this book on hand as a ready source of information on such diverse topics as lethals (which are listed in detail, giving references to the scientific literature) and beef cattle nutrition. The chapter on the feeding of beef cattle, for instance, contains 137 pages and includes tables in which information is presented on feed requirements, feed substitution, hormone and other accessory ration ingredients, and nutritional diseases of cattle.

Dr Ensminger is to be congratulated on presenting this edition which contains so much of interest. The book, however, is not recommended for the advanced student because it fails to treat any of the topics in depth.

COMMERCIAL SHEEP MANAGEMENT, by H. G. Clarke (1963). 140 pp., illus. Crosby Lockwood, London. Price £1 1s. (stg.).

THIS book both annoyed and amused me. Its author is a farmer who has tried to keep in touch with scientific developments in Great Britain but in many instances has failed to appreciate the full significance of the research findings. In these cases, he is often unjustifiably critical. Here is an example. Clarke and the farming community of Great Britain must be extremely knowledgeable if he can state: "Over the last few years I have attended some forty or more major conferences but I can scarcely recall even half a dozen where anything at all was brought out which had any value to farmers."

The author on p. 6 praises New Zealand lamb and its marketing but he is quite wrong when he states: ". . . overseas lambs are not confined to one weight range, indeed, there are about five such ranges which cover weights from 28 to 42 lb, with grades up to 56 lb as hoggets." His next sentence is meaningless, "But so well are these ranges supplied to this country that our butchers can buy their full needs from any one range."

In opening the chapter on sheep pens, he writes: "During the last ten years pens with dipping baths of every conceivable design have been offered to the farmer. At the most expensive extreme we have

the highly complicated New Zealand arrangement with an adjoining sheep house." Few New Zealand sheep farmers would agree that sheep dipping pens or other associated facilities are "highly complicated".

A review is made of various breeds of sheep and the conclusion is reached that, of the 36 breeds in Great Britain, probably less than a quarter should be retained. Clarke in another place hits out at the stud breeder when he asserts: "Unfortunately, some pedigree breeders . . . behave as though pedigree breeding and showing was an industry entirely divorced from agriculture." And again: "Besides it [certification of rams' fleeces for livestock improvement] would be a first step towards judging on economical grounds, and could even raise some of our breeders from fanciers into farmers."

The book is a rambling and loose account of a few aspects of sheep management; some points are well made but others are either ill-informed or are of little importance. The contents of some chapters bear little or no relation to chapter titles and this is particularly the case in Chapter 9 — Breeding from Ewe Lambs. Several printing and grammatical errors were noted. It was of interest to learn, however, that the index had been compiled by a member (Dr Muriel Lock) of the Society of Indexers. The book, nevertheless, does not match the quality of its well-prepared index.

Because *Commercial Sheep Management* is not an authoritative work, contains many unsound statements, and is concerned only with the British sheep farming scene, the book is definitely not recommended to New Zealand readers.

SHEEP MANAGEMENT FOR WOOL PRODUCTION, by V. G. Cole (1963). 184 pp., illus., Grazcos Co-operative Ltd., Sydney. Price £2 5s. 0d. (N.Z.).

THE AUTHOR of *Sheep Management for Wool Production* is the chief technical advisor to the publisher and is the veterinary consultant to the Graziers' Association of New South Wales. In these two positions he has come into close contact with sheep owners and is familiar with their problems in all States of the Commonwealth of Australia.

The book has five chapters: Introduction; Breeding; Feeding; Health; Relative importance of breeding, feeding and health to wool production. Although the title implies that wool production will be given prominence, a reading of the book would fail to confirm this; rather, the discussion covers many facets of sheep production of which wool is only one.

References are frequently made to Australian and New Zealand research work but these appear to rely mainly on statements in annual reports of research organizations. Literature citations are absent so that the serious reader is unable to trace the source of the research quoted and only in a very few cases are the authors of the research findings named. The text is, therefore, in disagreement with the preface which states: "A great number of articles in many different journals have been consulted in the preparation of the book. In most cases, the source of any information used has been acknowledged in the text and any omissions have been unintentional".

The chapter on breeding is the least satisfactory and there are indications that the author is unfamiliar with his subject. This is especially so when he discusses selection which is treated rather superficially. One sentence on p. 30 serves to illustrate the lack

of appreciation of the subject. It is: "Research has shown that it is most important to introduce accurate selection wherever possible into the selection of animals".

There are other curious sentences and questionable statements in the book, of which the following are examples: "When a ram's fertility is lowered for any reason the quality of its semen deteriorates. The number of live and active sperms decreases. This is readily detected by microscopic examination of the semen but can also be detected by the feel of the testicles" (p. 37). "Maintain topdressings with superphosphate to reduce clover dominance and establish grasses" (p. 73). "Ewes which lamb in the spring and are shorn in the spring must be shorn before or after lambing" (p. 93). Quoting the ryegrass strain trials at Massey University, the author states: "It [lower liveweight gains of the sheep grazing perennial ryegrass] was not due to differences in palatability as the sheep on the ryegrass alone ate most of all" (p. 116). "Each animal at birth inherits from its parents a certain potential for wool production" (p. 168). "The commercial flock owner has two ways in which he can increase the wool production of his flock through selection. First, through the ewes and, second, through the rams" (p. 168).

There are numerous printing errors throughout the book and the illustrations are not in juxtaposition with the references to them in the text. For instance, Figures 38 and 43 are opposite page 121, and Figure 44 is on page 149. This difficulty would have been overcome if the half-tone illustrations had been referred to as plates. There is some tedious repetition in places as well.

If the manuscript had been critically revised and the printing of the book undertaken with attention to detail, it could fill a worthwhile place in the library of a sheep producer. It is the hope of this reviewer that in its second edition it will appear without these annoying errors and imperfections.

THE SIMPLE FLEECE. Edited by A. Barnard (1962). 640 pp., illus., clothbound. Melbourne University Press in association with The Australian National University. Price £3 3s. 0d. (Aust.).

The Simple Fleece is a collection of 40 chapters each prepared by an Australian authority. The chapters are grouped into seven parts, the titles of which are: The fibre; the sheep; the land and its uses; production and finance; regional studies; wool marketing; epilogue. The writing throughout is clear and the reader would have little difficulty in understanding the very wide range of subjects discussed. Indeed, the book developed from a seminar attended by specialists from different disciplines who had come together to consider many aspects of wool in the Australian economy. The seminar held upwards of 40 meetings over a period of three years.

The book's sub-title: "Studies in the Australian Wool Industry" conveys a better idea of its scope than that given by the main title. The fleece and its products are by no means simple; the key to the title is given in the following lines:

> What bales, what wealth, what industry, what fleets!
> Lo, from the simple fleece, how much proceeds.
>
> —John Dyer, *The Fleece* (1757), III, 630–1.

The book production is first-class and the index is detailed and useful. The only defect found was Fig. 1 opposite p. 187 where the block was inverted in the printing.

As a survey of knowledge of the sheep and its fleece no other book approaches *The Simple Fleece* for thoroughness, for illustration, or for authority. The book is highly recommended for a wide audience encompassing the woolgrower, the businessman, the economist, the biologist, the geneticist, the wool technologist, the politician, the scholar. All who read it will be amazed at its collection of facts and the penetrating manner in which each facet of the vast and complex Australian wool industry is presented. Although it is concerned exclusively with Australia, the New Zealand reader cannot fail to profit from a study of this scholarly tome.

CROSSBREEDING BEEF CATTLE, ed. by T. J. Cunha, M. Koger and A. C. Warnick (1963), 228 pp., illus. University of Florida Press, Gainesville, U.S.A. Price $8.50.

THIS BOOK is a compilation of the reports presented by speakers at the Beef Cattle Short Course on Crossbreeding held at the University of Florida in 1961. There are 31 chapters, each prepared by an acknowledged authority in his field.

Among the various subjects covered, the following is a sample: Beef cattle in various areas of the world; breeds and strains from crossbred foundations; response to environment; blood composition and physiology of Brahman and Herefords; hybrid vigour and feed conversion; reproductive performance; mothering ability; milk production; crossing British breeds; calf performance from weaning to feedlot; hybrid calf fattening; effect of breeding on tenderness; practical crossbreeding plans.

Most chapters conclude with a short summary. A simple presentation of experimental results, some not published before, is a feature of the book. There are numerous well-chosen illustrations. A useful list of references and an index are also given.

This is an excellent publication which will be a useful reference work on the important subject of crossbreeding of beef cattle. Cattle breeders, meat technologists and students of animal husbandry will all find much of value to them in this readable book.

DISEASES OF CATTLE, by V. G. Cole (1965), 188 pp., illus. Grazcos Co-operative Ltd., Sydney. Price £3 (Aust.)

THIS BOOK will fill a long-felt want in Australia but there is also much of value for the cattle producer in New Zealand. It is a readable, up-to-date reference source of cattle diseases, not all of which fortunately occur in New Zealand. More than 150 diseases are discussed in a simple manner that can be readily understood by the non-veterinarian. Proprietary drugs for the treatment of infections and for the control of internal and external parasites are also reviewed and their effectiveness evaluated.

With a few exceptions, the dose rates for the treatment of animals suffering from specific conditions are not given. This makes the book of limited value to the cattleman capable of diagnosing the disease and able to apply the appropriate treatment to a sick animal. The absence of a veterinarian in some districts makes it imperative for the farmer to treat his animals suffering from a curable disease; therefore there is a real need for a book giving full

instructions and details of the required treatments. It is unhelpful to the livestock industry for veterinary authors not to make this kind of information freely available to their readers.

Despite this criticism, *Diseases of Cattle* is recommended as a book that should be on the shelves of all cattlemen. It will give them a better understanding of procedures in disease prevention and this is usually more important than a knowledge of the techniques of treatment.

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